Specifications For

BP1: Office Addition & Renovations

Harbor Beach Community Schools

402 S 5th St,
Harbor Beach, Michigan 48441

Owner

Harbor Beach Community Schools

402 S 5th St,
Harbor Beach, Michigan 48441

Issued For: Construction
Date: August 28, 2026

integrated designs inc.
IDI ARCHITECTURE ENGINEERING CONSULTING

Project Number

24-128

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SECTION 003121
SITE SURVEY INFORMATION

PART 1 - GENERAL

1.1 SURVEY INFORMATION

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.

B. The Site Survey, completed by Nederveld dated, January 12, 2026, was used for the bases of design and, is available upon request.

END OF SECTION 003121

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GEOTECHNICAL EVALUATION REPORT

PROPOSED BUILDING ADDITIONS
HARBOR BEACH K-12 COMMUNITY SCHOOL
402 SOUTH 5TH STREET
HARBOR BEACH, MICHIGAN

SME PROJECT NO. BG40743
FEBRUARY 4, 2002

Consultants in the geosciences, materials and the environment

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- *Instrumentation*
- *Settlement Analysis*
- *Site Condition Assessment*
- *Slope Stability*
- *Building Restoration*
- *Coatings*
- *Concrete*
- *Condition Survey*
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- *Environmental Site Assessment*
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- *Landfill Services*
- *Pollution Prevention*
- *Regulatory Compliance*
- *Remediation*
- *Risk Assessment*
- *Storm Water Discharge*
- *Underground Storage Tanks*

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February 4, 2002

Mr. Dan Jerome
French Associates
1600 Parkdale
Rochester, Michigan 48307

RE: Geotechnical Evaluation Report
Proposed Building Additions
Harbor Beach K-12 Community School
402 South 5th Street
Harbor Beach, Michigan
SME Project No. BG40743

Dear Mr. Jerome:

We have completed the geotechnical evaluation for the proposed additions to Harbor Beach K-12 Community School located in Harbor Beach, Michigan. This report presents the results of our observations and analysis, and our recommendations for subgrade preparation, foundations and preliminary pavement design. Furthermore, our report contains a brief discussion regarding construction considerations related to the geotechnical conditions disclosed by the soil borings.

Implementation of our recommendations may affect the design, construction and performance of the structure and related facilities, along with the potential inherent risks involved with the proposed construction. The client and key members of the design team, including SME, should discuss the issues covered in this report so that the issues are understood and applied in a manner consistent with the owners' budget, tolerance of risk, and expectations for performance and maintenance.

We once again appreciate the opportunity to be of service to you. If you have any questions regarding this report, please feel free to contact us.

Very truly yours,

SOIL AND MATERIALS ENGINEERS, INC.

Joseph L. Noykos
Senior Engineer

J. William Coberly, CET
Project Consultant

Enclosures: Two originals

Detroit
Bay City
Grand Rapids
Kalamazoo
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Toledo

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GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
SOIL BORING LOGS (B1 THROUGH B14)

SUMMARY

The report conclusions and recommendations are summarized as follows:

1. Soil conditions encountered at the soil boring locations generally consist of topsoil overlying natural, brown stiff to hard, silty/sandy clays and/or hard clayey silts. The natural silts and clays were underlain by hard, gray silty clays, clayey silts or dense to extremely dense silty sands, which extended to the explored depths of the soil borings performed within the footprint of the proposed additions.

2. On average, about 1.5 to 3 feet of mixed sand, silt and clay fill was encountered beneath the topsoil at the soil borings performed near the existing building within the footprint of the southeast addition (B1, B2, B5, B8). However, at soil boring B2, the fill extended to about 6 feet below the existing ground surface. The fill materials encountered at soil borings B1 and B2, based on laboratory testing, were moderately organic. About 12 inches of clay fill was encountered at the soil boring performed near the north end of the proposed parking/drive area to be located west of the existing building (B13).

3. Spread footing foundations, extending through the topsoil, fill, and unsuitable natural soils to bear on the natural silty/sandy clays or clayey silts, or on engineered fill overlying these soils, are recommended for support of the proposed additions. A maximum net allowable soil bearing pressure of 4,000 psf is recommended for the proposed additions. In general, suitable natural bearing soils are expected to be encountered just below the existing ground surface. However, at areas of the site where fill materials are present, such as at soil borings B1, B2, B5 and B8, we generally expect suitable natural bearing soils to be encountered at about 2.5 to 3.5 feet below the existing ground surface. At the soil boring performed near the southeast corner of the existing building (B2), the fill extended to about 6 feet below the existing ground surface. Due to the high susceptibility of disturbance to the foundation bearing soils, foundation concrete should be placed shortly after excavation.

4. Once the site has been stripped of all topsoil, the underlying subgrade soils are generally expected to consist of natural clays, or isolated areas of mixed fill materials. Based on the available soil boring information, the natural clay soils, and most of the existing fill, appear suitable for the support of grade slabs and pavements, once proper preparation of the exposed subgrade has been completed. However, the moderately organic mixed fill soils encountered at soil borings B1 and B2 (organic content greater than 4% by weight) represent an increased risk of poor grade slab performance. If this risk is deemed unacceptable, then it will be necessary to completely remove these soils and replace with compacted engineered fill. To aid in delineating these areas of unsuitable fill soils, test pits and additional soil testing could be performed after stripping the site.

5. Based on the soil borings, significant groundwater seepage is not anticipated during excavation activities. However, some localized seepage may occur from wet silt and sand seams observed within the natural clays encountered at soil borings B7, B10 and B12. We anticipate standard sump pit and pumping procedures will be adequate to handle such seepage, where encountered, and ponding of surface run-off.

6. Pavement design recommendations are contained in Section 5.0 of this report. The recommendations contained in this section shall be considered preliminary until specific traffic loading information, and a final grading plan are reviewed by our office.

The summary presented above includes selected elements of our findings and recommendations and is provided solely for purposes of overview. It does not present crucial details needed for the proper application of our findings and recommendations. It should therefore not be considered apart from the entire text of this report and appendices, with all the qualifications and considerations mentioned therein, which are best evaluated with the active participation of SME.

REPORT PREPARED BY:

Joseph L. Noykos
Senior Engineer

Jason Schwartzenberger, PE
Senior Engineer

REPORT REVIEWED BY:

Timothy H. Bedenis, PE
Chief Geotechnical Engineer

Chuck A. Gemayal, PE
Senior Associate

1. INTRODUCTION

This report presents the results of our geotechnical evaluation for the proposed additions to Harbor Beach K-12 Community School in Harbor Beach, Michigan. This evaluation was conducted in general accordance with the scope of services outlined in our proposal dated December 12, 2001. Please refer to that proposal for the specific scope of services. Mr. Dan Jerome of French Associates, the project architect, authorized this evaluation.

1.1 Site Conditions

At the time of the site reconnaissance, the building site consisted of generally flat, grass-covered land with the existing Harbor Beach Community School noted west and north of the proposed additions. However, the existing grades generally increased near the existing school, indicating that likely about 3 to 4 feet of fill was previously placed to achieve final grades.

Based on a cursory review during the site reconnaissance, the existing structure, pavements and concrete pedestrian sidewalks appeared to be in relatively good condition.

1.2 Project Description

The Harbor Beach Community School District plans to construct two additions to the existing K-12 School located at 402 South 5th Street in Harbor Beach, Michigan. The large portion of the addition to be constructed at the southeast side of the existing school will house a gymnasium and appurtenances with the remaining portion containing an entryway. The addition at the southwest side of the existing school will contain classrooms and associated facilities.

The proposed gymnasium addition will be a high-bay, single-story, slab on grade structure with long roof spans. The remaining additions will be standard single story, slab on grade structures. We anticipate the proposed additions will be constructed of load-bearing masonry and structural steel with an architectural brick veneer. Moderate building loads, due to the increased column spacing, are expected in the gymnasium addition. Light to moderate building loads are expected in the remaining additions.

A combined asphalt concrete parking area and drive is proposed directly west of the existing building. Specific traffic loading information and a final grading plan was unavailable for review during our evaluation.

2. EVALUATION PROCEDURES

2.1 Field Exploration

A total of fourteen soil borings were performed for this evaluation on January 13, 2002 through January 15, 2002. The twelve soil borings performed within the footprints of the proposed building additions were extended to about 20 feet below the existing ground surface. The remaining two soil borings performed within the proposed parking/drive area were extended to about 7.5 feet below the existing ground surface. The approximate locations of the soil borings are shown on the Soil Boring Location Diagram included in Appendix A. Deviations from the planned locations are presented on the individual soil boring log. The number, depth and locations of the soil borings were determined by French Associates. The soil borings were located in the field by SME using existing site features as referenced on an undated Architectural Site Plan prepared by French Associates. Ground surface elevations at the soil boring locations were not determined for this evaluation.

The soil borings were drilled using a rotary-type, truck-mounted drill rig, and were advanced to the sampling depths using continuous flight hollow-stem augers. The soil borings included soil sampling based upon Split-Barrel Sampling Procedures. At completion of the soil borings, the boreholes were backfilled with auger cuttings. The samples were sealed in glass jars in the field and returned to the laboratory for further examination and testing.

Groundwater measurements were recorded during drilling and immediately after completion of the drilling operations. Since the boreholes were backfilled shortly after drilling, long-term water level information is not available from these soil borings.

The soil boring log includes materials encountered, penetration resistances, and pertinent field observations made during the drilling and excavating operations. The soil boring logs are included in Appendix A.

2.2 Laboratory Testing

The general laboratory testing program consisted of performing visual soil classification, moisture content, hand penetrometer and Torvane Shear tests on portions of cohesive samples obtained. Loss On Ignition (LOI) tests were performed on soil samples, which were suspected to have an elevated organic content. The results of the LOIs are contained in Section 3.1 of this report.

The soil samples were visually classified in general accordance with the Unified Soil Classification System (USCS). The estimated group symbol, according to the USCS, is shown in parentheses following the textural description of the various strata on the soil boring logs contained in Appendix A. The appended General Notes sheet includes a brief summary of the general method of describing the soil and assigning an appropriate USCS group symbol.

In the hand penetrometer test, the unconfined compressive strength of a cohesive soil sample is estimated by measuring the resistance of the sample to penetration of a small, calibrated spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tsf. The shear strength reported on the soil boring logs is theoretically one-half of the unconfined compressive strength

The Torvane device consists of a series of vanes, which are pressed into the soil sample. A torque is then applied through a calibrated spring until the soil fails along the cylindrical perimeter contact surface of the vanes. The value of the shear strength, in tsf, is read directly from the Torvane. Shear strength equals one-half of the unconfined compressive strength. The results of the laboratory testing are included on the attached soil boring logs.

Soil samples retained over a long period of time, even sealed in jars, are subject to moisture loss and are no longer representative of the conditions initially encountered in the field. Therefore, soil samples are normally retained in our laboratory for 60 days and then disposed, unless instructed otherwise.

3. SUBSURFACE CONDITIONS

3.1 Soil Conditions

Soil conditions encountered at the soil boring locations generally consist of topsoil overlying natural, brown, stiff to hard, silty/sandy clays and/or hard clayey silts. The natural silts and clays were underlain by hard, gray silty clays, clayey silts or dense to extremely dense silty sands, which extended to the explored depths of the soil borings performed within the footprint of the proposed additions. Mixed fill soils, with varying amounts of organics, were encountered at the soil borings performed within the southeast addition, near the south wall of the existing building, and at the soil boring performed near the north end of the proposed parking/drive area.

The following gives a generalized summary description of the soils encountered at the soil borings performed at the subject site, beginning at the ground surface and proceeding downward:

Stratum 1: Topsoil. Approximately 4 to 12 inches of topsoil was encountered at each of the fourteen soil borings drilled for this evaluation. About six inches of brown, clayey sand was reported underlying the topsoil at soil borings B4 and B6.

Stratum 2: Mixed Fill (CL/ML/SP). About 1 to 5.5 feet of mixed sand, silt and clay fill, with varying amounts of organics, was encountered extending from beneath the topsoil at soil borings B1, B2, B5, B8 and B13. Shear strengths obtained in the predominantly clay fill materials ranged from about 2.25 to 3.0 kips per square foot (ksf), indicating a very stiff condition. Moisture contents ranged from about 20 to 22 percent. Standard Penetration Resistances (N-values) obtained in the predominantly silty and sandy fill materials ranged from 3 to 5 blows per foot (bpf), indicating a loose to very loose condition.

The fill materials encountered at soil borings B1 and B2 were suspected to have an elevated organic content. The average organic content of these soils, based on LOI tests, was about 6 percent, which is considered to be moderately organic.

Stratum 3: Natural Clays and Silts (CL/ML-CL). Natural, brown to gray, silty/sandy clays and clayey or sandy silts were encountered extending either from beneath the topsoil or the Stratum 2 soils to the explored depths of the soil borings. Moisture contents in the natural clays ranged from about 9 to 23 percent, with an average moisture content of about 14 percent. Shear strengths in the natural clays ranged from 1.25 to greater than 4.5 ksf, indicating a stiff to hard condition.

N-values obtained in the natural silts, where encountered, ranged from about 10 to more than 100 bpf, indicating a medium to extremely dense condition. Shear strengths and moisture contents were obtained from samples of the natural silts with moderate clay contents (ML-CL). Shear strengths in these soils ranged from about 4.25 to greater than 4.5 ksf, indicating a hard condition. Moisture contents ranged from about 9 to 12 percent.

The soil descriptions and properties, in addition to groundwater conditions observed by the driller, are graphically presented in the soil boring logs appended to this report along with a soil boring location diagram. Please refer to the soil boring logs for the soil conditions at the specific soil boring locations. Stratification lines on the soil boring logs indicate a general transition between soil types. They are not intended to show an area of exact geological change. The soil descriptions are based on visual classification of the soils encountered.

3.2 Groundwater Conditions

During the drilling operations, groundwater was encountered at seven of the fourteen soil borings about 3 to 8 feet below the existing ground surface. Upon completion of the drilling activities, groundwater was encountered about 9 to 17 feet below the existing ground surface. Groundwater was not encountered at the remaining seven soil boring locations. Based on the measurements reported, it appears groundwater is trapped within natural silt and sand seams observed in the natural clays, or perched within the natural silts.

In cohesive soils such as clays (CL), and silts containing moderate amounts of clay (ML-CL), a long time may be required for the water level in the borehole to reach an equilibrium position. Therefore, the use of groundwater monitoring wells (piezometers) is necessary to accurately determine the hydrostatic water level within these types of soils. Thus, the short-term groundwater level readings at the soil boring locations during and after drilling likely do not represent an accurate depiction of the existing static groundwater. However, a change in color from brown to gray can sometimes be an indicator of the long-term groundwater level, and can sometimes be used to estimate the site groundwater levels. Based on the soil borings, the color change generally occurred at about 8 to 18 feet below the existing ground surface, with an average depth of about 12 feet below the existing ground surface.

Hydrostatic and perched groundwater levels and the elevations and volumes of groundwater should be expected to fluctuate throughout the year, based on variations in precipitation, evaporation, run-off and other factors. The groundwater levels indicated by the soil borings, and presented in this section, represent conditions at the time the readings were taken. The actual groundwater levels at the time of construction may vary.

4. ANALYSIS AND RECOMMENDATIONS

Based on the information available from the soil borings, shallow spread foundations are recommended for support of the proposed additions. The existing natural soils, and a majority of the existing fill materials, appear suitable for the support of grade slabs, pavements, or the placement of engineered fill. However, the moderately organic clay fill materials encountered at two of the soil borings drilled for this evaluation (B1 and B2) represents an increased risk of poor grade slab performance. If this risk is deemed unacceptable, then it will be necessary to completely remove these fill soils, where encountered, and replace with compacted engineered fill. To aid in delineating these areas, test pits and additional soil testing could be performed after stripping the site.

Significant groundwater seepage is not expected during construction. We anticipate normal sump and pit methods will be adequate to handle minor seepage and ponding of surface run-off, where encountered.

Our specific recommendations for site earthwork, foundations, slab-on-grade construction, and preliminary pavement design are presented below.

4.1 Site Preparation and Earthwork

4.1.1 General Site Subgrade Preparation

The footprints of the proposed additions and pavement areas, and 5 feet beyond, should be stripped of all vegetation, topsoil and other deleterious materials. After stripping of the site is performed, the subgrade conditions are generally expected to consist of natural clays, silts, sands and mixed fill materials.

The natural soils, and a majority of the existing fill materials, generally appear suitable for the support of grade slabs, pavements, and placement of additional fill (where required). However, based on the average organic content of the fill materials encountered at soil borings B1 and B2, which was about 6 percent by weight, we believe there is an increased risk of long-term settlement in these areas. The settlement will be primarily due to the decomposition of the organics within these soils. If this risk is unacceptable, then it will be necessary to completely remove these materials, and any other soils, which contain more than 4 percent organics by weight, and replace with compacted engineered fill. Additional probing and soil testing could be performed prior to and/or during site preparation to further evaluate the potential areas to be undercut. Engineered fill placed for this purpose should be compacted per the "Engineered Fill Requirements" section of this report (Section 4.1.3)

Prior to beginning placement of engineered fill in low or undercut areas of the site, the exposed subgrade should be thoroughly evaluated by SME. Soft or loose areas will require compaction or additional undercutting and replacement with engineered fill or crushed aggregate. The amount of undercutting required and the type of fill necessary to achieve a stable subgrade will depend on the specific site conditions encountered during construction.

During site preparation and below placement of fill, the proposed building footprints and pavement areas should be thoroughly proofrolled in the presence of the geotechnical engineer (SME). The purpose of proofrolling is to locate areas of unsuitably loose or soft subgrade soils and to uniformly compact the subgrade surface. Areas of unsuitable subgrade revealed during proofrolling should be mechanically stabilized (compacted) in place. If it is not possible to compact the unsuitable subgrade, it may be necessary to remove the

unsuitable soils and replace with engineered fill. Proofrolling should be performed with a fully loaded, tandem axle truck, or other suitable piece of pneumatic-tired construction equipment.

The existing subgrade soils are highly susceptible to disturbance due to ponded water and channelized construction traffic. Therefore, the contractor should be prepared to remove ponded standing water from areas where water collects, and prevent surface water run-off from reaching the footing excavations and the prepared subgrade. In addition, construction traffic should use designated haul roads and should not be allowed to randomly traffic the site. Subgrade soils, which become disturbed, should be removed and replaced with engineered fill or crushed aggregate.

Engineered fill placed for utilities, walks and slabs, should be placed and compacted per the recommendations in the "Engineered Fill Requirements" section of this report (Section 4.1.3).

4.1.2 Subgrade Preparation for Floor Slabs

Once the subgrade has been prepared as discussed in the previous section, and prior to concrete placement, the final floor slab subgrade in the below-grade areas should be observed and tested by SME and again thoroughly proofrolled. Disturbed areas indicated by SME should be recompacted or removed and replaced with engineered fill.

We recommend the top 4 inches of the slab subgrade consist of an approved granular material. The purpose of this is to provide a leveling surface for construction of the slab and to provide a moisture capillary break between the slab and the underlying soils. In addition, this will protect the subgrade prior to placement of the slab. MDOT Class II or MDOT 22A material is recommended for this purpose. The material should also be compacted per the "Engineered Fill Requirements" section of this report (Section 4.1.3).

To permit relative movement, slabs should be separated by isolation joints from structural walls and columns bearing on their own footings. A minimum of six inches of engineered fill should be provided between the bottom of the slab and the top of the shallow spread footing below, or grade beams, or other arrangements should be made to allow for relative settlements. We also recommend a vapor barrier be provided below the floor slab if the slab is to receive an impermeable floor finish/seal.

4.1.3 Engineered Fill Requirements

Any fill placed within the footprints of the proposed additions, including utility trench backfill, should be an approved material, free of frozen soil, organics, or other deleterious materials. The fill should be spread in level layers not exceeding 9 inches in

loose thickness and should be compacted to a minimum of 95 percent of the maximum dry density as determined in accordance with the Modified Proctor test.

Based on the information from the soil borings, the existing natural clays are generally considered suitable for use as engineered fill provided they meet the general requirements listed in the previous paragraph, and do not contain more than 4 percent organics by weight. The majority of the existing fill materials does not appear suitable for use as engineered fill and should be placed in greenbelt areas (such as for landscaping berms), or removed from the site. Furthermore, we do not recommend the existing natural silts (ML/CL-ML) be used as engineered fill due to the difficulty in preparing and compacting such soils. If it is necessary to reuse the existing silts, SME would be pleased to provide more specific recommendations regarding the preparation, placement of compaction of these soils.

The moisture contents of the clays ranged from about 9 to 23 percent. These soils are moisture sensitive and will likely require some conditioning (i.e., wetting or drying) to achieve the required compaction levels. The success of moisture conditioning of clay soils is dependent on the time of year, the associated weather conditions, and the contractors' effort. Also, clayey soils are very difficult to compact in confined areas where compaction by hand-operated equipment is required. If the existing clayey soils from the foundation or utility excavations are reused for fill in other areas of the site, we recommend the fill be placed in relatively large open areas where the moisture content can be controlled and the proper compaction equipment used.

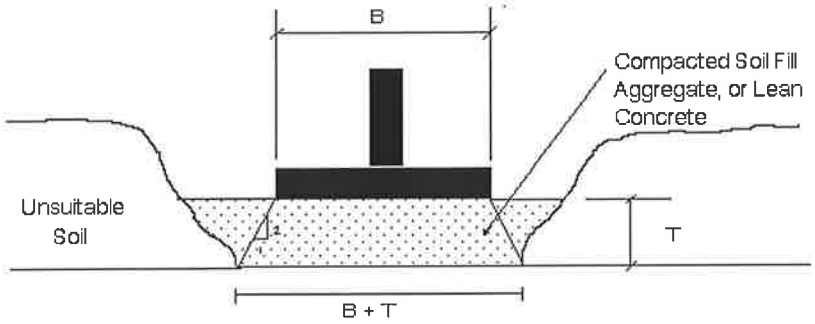
In confined areas (such as backfill for foundations, below-grade walls or utility trenches), and other areas where compaction is accomplished primarily by hand-operated equipment, or where drainage is required, granular material meeting the gradation requirements of MDOT Class II is recommended as backfill. Additionally, in pavement areas and adjacent to below-grade walls, the Class II sand backfill should be topped with 18 inches of compacted clay to shed rainwater away from the building, and to provide a uniform subgrade and prevent stormwater accumulation in sand trenches.

4.2 Foundations

Based upon the results of the fourteen soil borings drilled for this evaluation, shallow spread foundations are recommended for support of the proposed building additions. A maximum net allowable soil bearing pressure of 4,000 psf is recommended for footings extending through the topsoil, fill and unsuitable natural soils to bear on the natural silts and clays, or on engineered fill overlying these soils. Suitable natural bearing soils are generally

expected to be encountered from just beneath the existing ground surface, to about 3.5 feet below the existing ground surface. However, at the soil boring performed near the southeast corner of the existing building (B2), the fill materials extended to about 5.5 feet below the existing ground surface. Therefore, the footings in this area will likely need to be extended to at least this depth to attain suitable natural bearing soils, or placed on engineered fill overlying these soils. Test pits and additional testing could be performed prior to construction to aid in delineating the extent of the existing fill, and the amount of removal required to achieve suitable bearing soils.

As an alternative to extending the footings deeper than normal through the existing fill materials, where encountered, the fill soils could be removed and replaced with compacted engineered fill. The footings may then be constructed on the engineered fill at nominal footing depths. Engineered fill placed to support structures, such as foundations, should be compacted to a minimum of 95 percent of its Modified Proctor density. For footings constructed on engineered fill, the lateral extent of the undercut should be at least one-half foot for each foot of undercut from the edge of the footing. Please refer to the Typical Foundation Undercutting Diagram below:



Foundations should be situated a minimum of 42 inches below final grade for protection against frost action during normal winters. In heated areas of the structure, interior footings may be constructed just below the floor slabs, provided the footings bear on suitable natural soils or on engineered fill overlying these soils, and the footings are protected from freezing conditions during construction. If foundation construction occurs during the winter, the foundations must be protected from frost action either by embedment or proper insulation. Also, for frost heave considerations, it is important to maintain a near

vertical trench sidewall for the footing and not allow the footing to "mushroom out" at the top.

Based on the encountered soil conditions, it appears the foundations can be 'bank poured', provided the sidewalls can be kept near vertical. If excessive caving and sloughing of the sidewalls occurs, it will be necessary to slope back the excavations and place forms for the footings and foundation walls.

For bearing capacity and settlement considerations, isolated spread footing type foundations should have a minimum dimension of at least 30 inches, and continuous strip footing foundations should be at least 18 inches wide.

We estimate total settlement for spread foundations for the proposed buildings, using the recommended bearing pressure, to be 1 inch or less. Differential settlements are estimated to be about one-half the total settlement. The settlement estimate provided is based on the available soil boring information, our understanding of the project, and the anticipated light to moderate structural loads.

4.3 Construction Considerations

The existing groundwater conditions are not expected to significantly affect foundation and utility excavations. Some minor seepage may be encountered from perched and trapped groundwater accumulations. However, standard sump pit and pumping procedures should be adequate to control such seepage.

As indicated in the previous sections, the foundation bearing soils are highly susceptible to disturbance during construction. Disturbed foundation bearing soils should be removed and replaced with engineered fill or a coarse crushed aggregate or crushed concrete.

All excavations should be sloped, shored, or braced in accordance with MI-OSHA requirements. The contractor should provide an adequately constructed and braced shoring system for employees working in an excavation that may expose employees to the danger of moving ground. If material is stored or heavy equipment is operated near an excavation, stronger shoring must be used to resist the increased pressure due to the superimposed loads.

The contractor should take precautions to protect adjacent utilities, roadways and structures during construction.

5. GENERAL COMMENTS

Basis of Geotechnical Report

This report has been prepared in accordance with generally accepted geotechnical engineering practices to assist in the design of this project. If the site plan or the project's design criteria are changed, contained in this report shall not be considered valid unless the variations are reviewed, and the conclusions of this report are modified or approved in writing by our office.

The discussions and recommendations submitted in this report are based on the available project information, described in this report, and the data obtained from the fourteen soil borings performed at the approximate locations indicated on the appended location plan. This report does not reflect variations, which may occur between or away from the soil borings. The nature and extent of the variations may not become evident until the time of construction. If significant variations become evident, it may be necessary for us to reevaluate the recommendations of this report.

In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering. Specifically, field logs are prepared during the drilling and sampling operations that describe field occurrences, sampling locations, and other information. Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory and differences may exist between the field logs and the report logs. The engineer preparing the report reviews the field logs, laboratory classifications, and test data and then prepares the final report logs. Our recommendations are based on the contents of the report logs and the information contained therein.

Design, Plan and Specification Review

As part of our continued service to the project, we should be retained to review the design details, project plans and specifications to verify the project factors affecting subgrade, foundation and pavement performance are consistent with the design recommendations set forth in this report.

Project Information for the Client

This report presents the results of our observations and analyses, our recommendations for subgrade preparation, foundations design, and construction considerations. Implementation of our recommendations may affect the design, construction

and performance of the structure and related facilities along with the potential inherent risks involved with the proposed construction. The client and key members of the design team, including SME, should discuss the issues covered in this report so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk and expectations for performance and maintenance

Field Verification of Geotechnical Conditions

The site earthwork operations should be observed and tested by SME to verify subgrade soils are suitable for construction of foundations, slabs-on-grade, pavements and placement of engineered fill, and to verify engineered fill for the structure, pavements and other structures is properly placed and compacted. The foundation construction activities should be observed by SME, and the foundation bearing soils tested by SME to verify conditions are as anticipated. As geotechnical engineering firm that performed the geotechnical evaluation for this project, SME is well suited to verify the recommendations of this report are properly incorporated in the design of this project, and properly implemented during construction.

Project Information for Contractor

This report and any future addenda or reports should be made available to bidders prior to submitting their proposals and to the successful contractor and subcontractors for their information only and to supply them with facts relative to the subsurface evaluation and laboratory test results. If the contractor encounters conditions during construction, which differ from those, presented in this report, he/she should promptly notify the owner so that the geotechnical engineer can be contacted to verify those conditions. Subsequently, the contractor should describe the nature and extent of the differing conditions in writing. We recommend the construction contract include provisions for dealing with differing conditions and contingency funds should be reserved for potential problems during earthwork and foundation construction. We would be pleased to assist you in the contract provisions based on our experience.

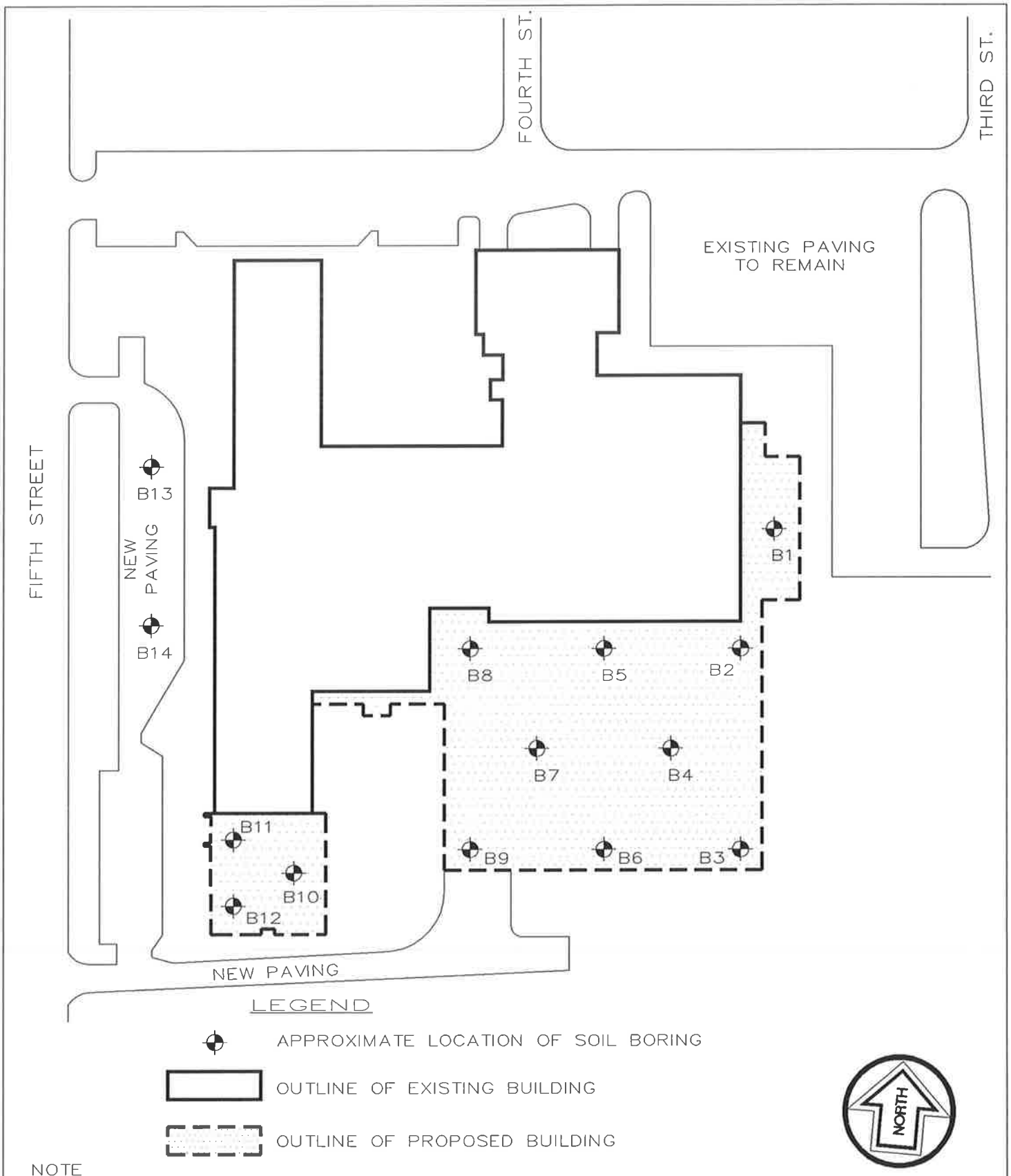
Furthermore, the contractor should be prepared to handle environmental conditions at this site which may affect the excavation, removal, or disposal of soil, dewatering of excavations, and health and safety of workers. Any environmental assessment reports prepared for this property should be made available for review by bidders and the successful contractor.

Third Party Reliance/Reuse of This Report

This report has been prepared solely for the use of the client for the project specifically described in this report. Other parties who are not involved with this current project and have interests in this site for future development cannot rely on the recommendations provided in this report. Therefore, SME is not responsible for the suitability of the field exploration, scope of services or interpretation by others of our soil boring logs and the recommendations provided herein. SME would be pleased to evaluate the information developed from this evaluation for other developments at this site, provided the client who retained SME for this evaluation allows SME to use that information, confirmed in writing from that client. However, this does not include modifying this original report and changing the date to accommodate other parties since the new project may require further field exploration, laboratory tests and analysis to adequately address the needs of the new project. Furthermore, other parties who engage SME's service must be bound by the SME's general terms and conditions prior to proceeding with future evaluations.

APPENDIX A

1. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT
2. SOIL BORING LOCATION DIAGRAM
3. GENERAL NOTES
4. UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
5. SOIL BORING LOGS (B1 THROUGH B14)



NOTE
DRAWING BASED ON ARCHITECTURAL SITE PLAN PREPARED BY FRENCH ASSOCIATES.

43980 PLYMOUTH OAKS BOULEVARD
PLYMOUTH, MICHIGAN 48170
(734) 454-9900

BAY CITY
GRAND RAPIDS
KALAMAZOO
LANSING
PLYMOUTH
TOLEDO

DATE	01-31-02
DRAWN BY	MBA
SCALE	1" = 100'
JOB	BG 40743

SOIL BORING LOCATION DIAGRAM
PROPOSED ADDITION
HARBOR BEACH SCHOOLS
HARBOR BEACH, MICHIGAN

FILE NAME H:40000\40743.DWG

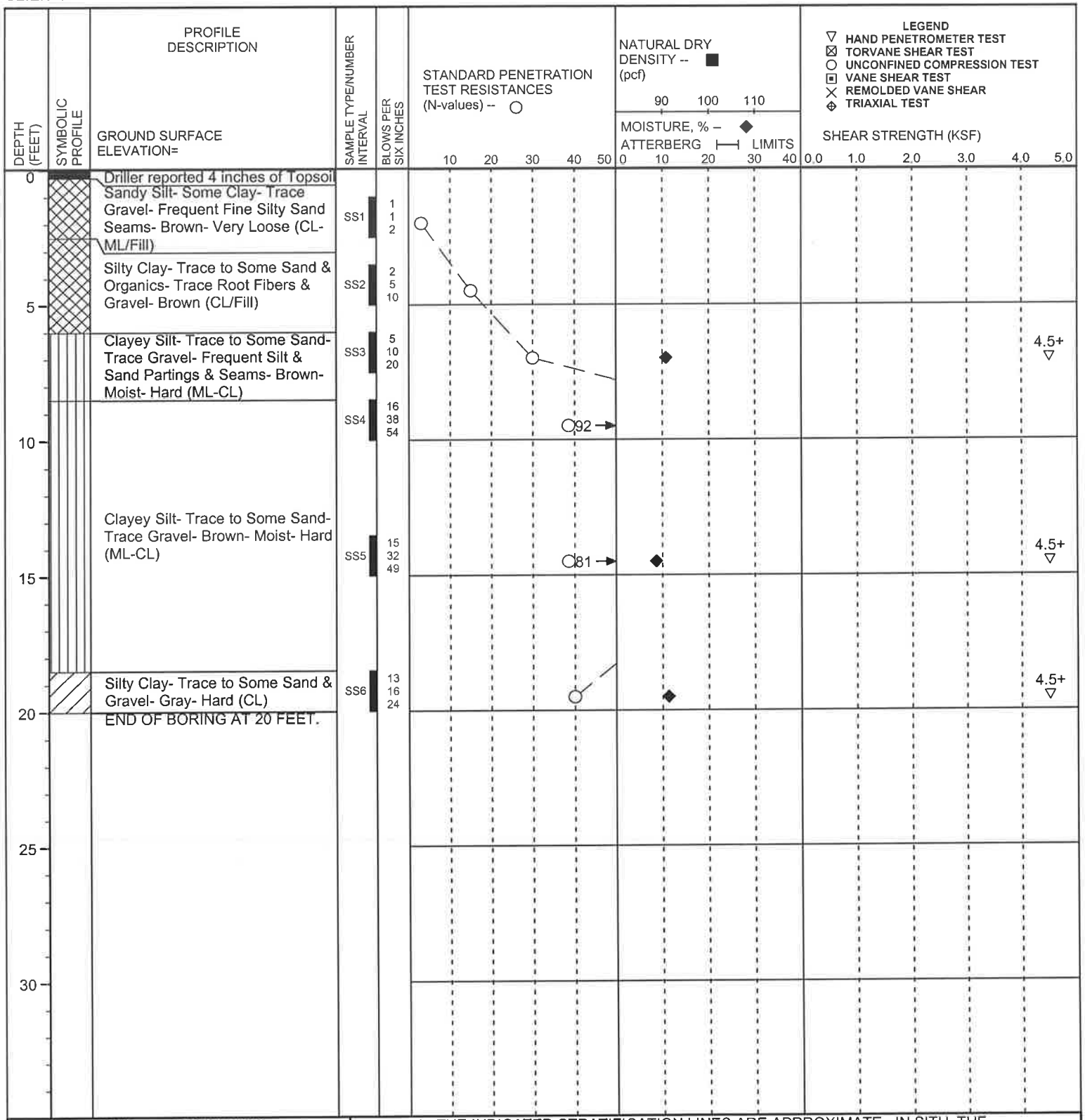
Figure No. 1

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION **A/E:** FRENCH ASSOCIATES

PROJECT LOCATION: HARBOR BEACH, MICHIGAN **BY:** RCT/JLN **DATE:** 1/15/02 **BORING B1**

CLIENT: HARBOR BEACH COMMUNITY SCHOOLS **PROJECT NUMBER:** BG40743 **SHEET:** 1



WATER LEVEL OBSERVATIONS

GROUNDWATER ENCOUNTERED DURING DRILLING

GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

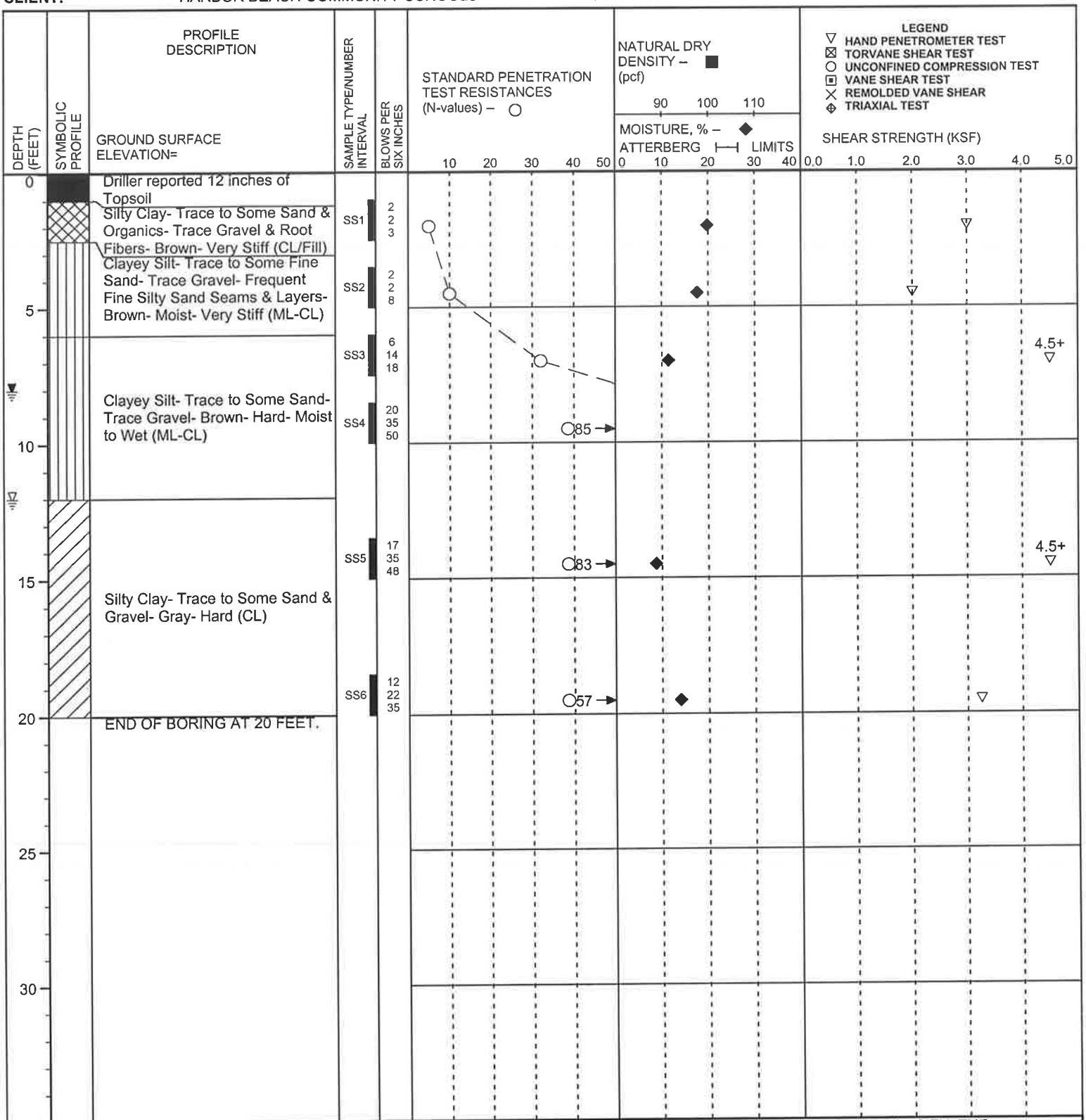
Notes: 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. GROUNDWATER WAS NOT ENCOUNTERED.
3. SOIL BORING OFFSET 70 FEET NORTH & 5 FEET EAST OF SOUTHEAST CORNER OF BUILDING DUE TO WET/SOFT SURFACE CONDITIONS.

DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** **WATER LEVEL** **HOURS AFTER COMPLETION:**

RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** **CAVE OF BOREHOLE AT**

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION
A/E: FRENCH ASSOCIATES
PROJECT LOCATION: HARBOR BEACH, MICHIGAN
BY: RCT/JLN **DATE:** 1/15/02 **BORING B2**
CLIENT: HARBOR BEACH COMMUNITY SCHOOLS
PROJECT NUMBER: BG40743 **SHEET:** 1



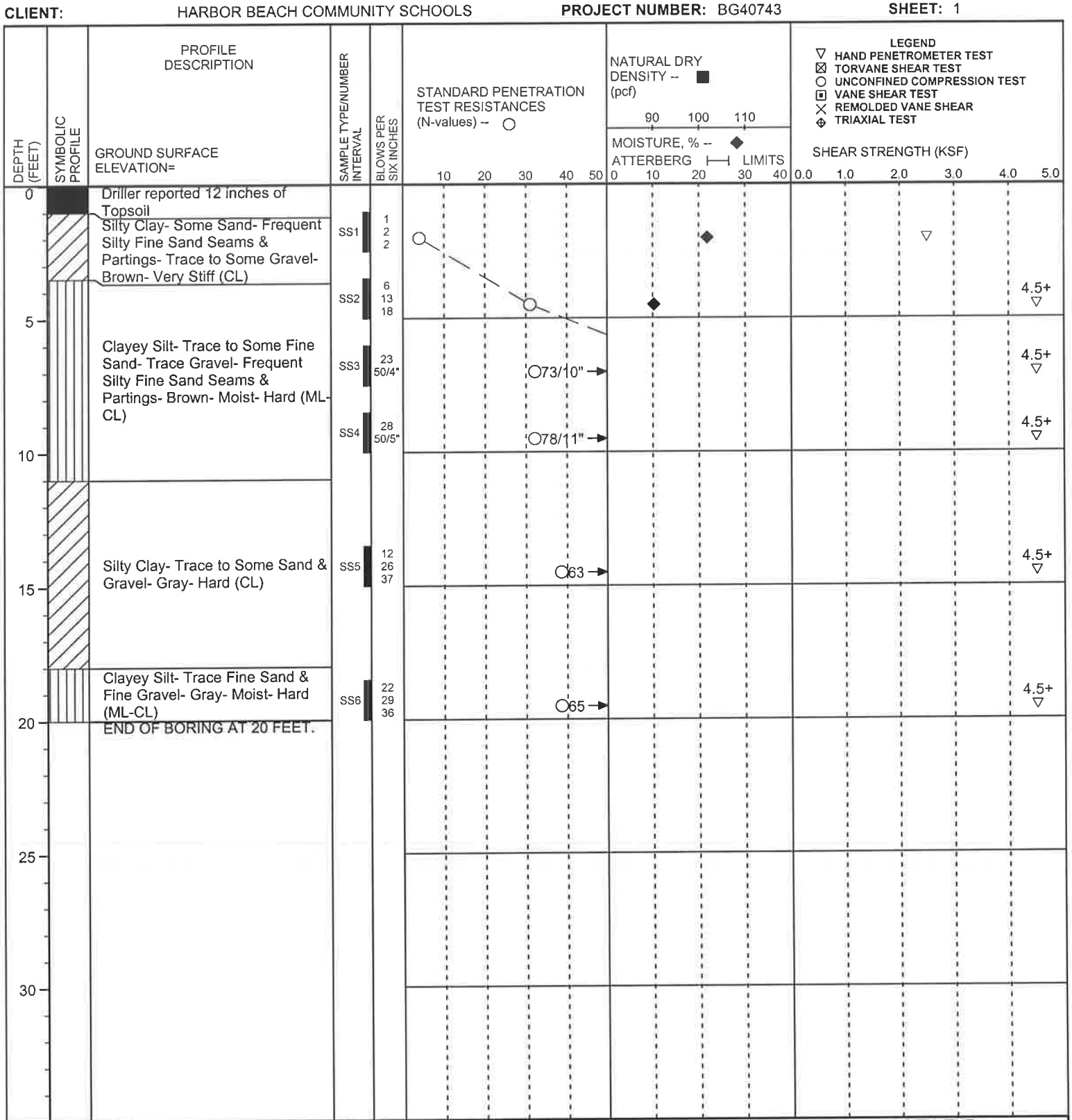
WATER LEVEL OBSERVATIONS
▼ GROUNDWATER ENCOUNTERED DURING DRILLING
▽ GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. SOIL BORING OFFSET 15 FEET NORTH OF DESIRED LOCATION DUE TO WET/SOFT SURFACE CONDITIONS.

DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** 8 **WATER LEVEL HOURS AFTER COMPLETION:**
RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** 12 **CAVE OF BOREHOLE AT**

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION
A/E: FRENCH ASSOCIATES
PROJECT LOCATION: HARBOR BEACH, MICHIGAN
BY: RCT/JLN **DATE:** 1/14/02 **BORING** B3
CLIENT: HARBOR BEACH COMMUNITY SCHOOLS
PROJECT NUMBER: BG40743 **SHEET:** 1



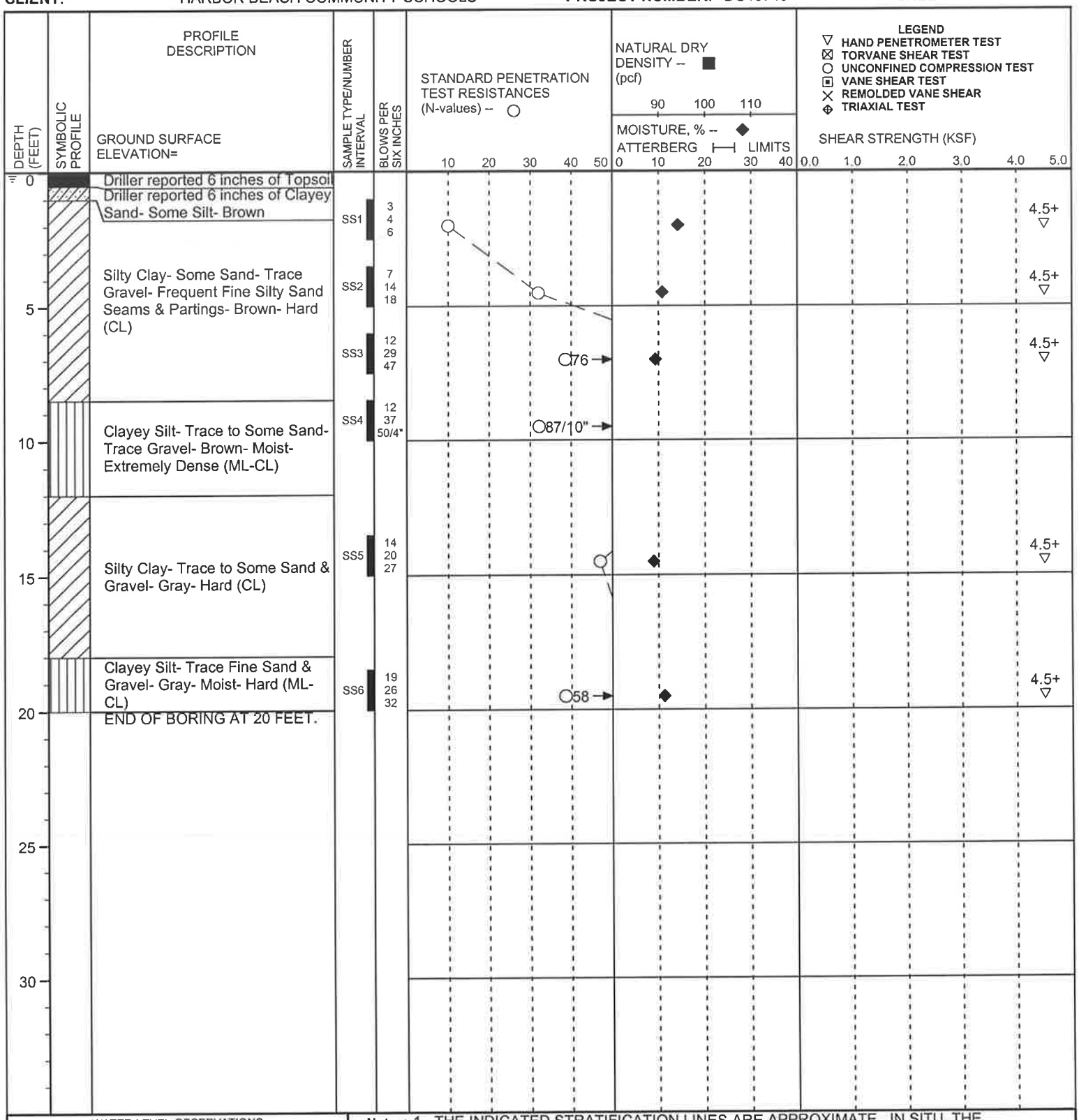
WATER LEVEL OBSERVATIONS
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. GROUNDWATER WAS NOT ENCOUNTERED.

DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** **WATER LEVEL** **HOURS AFTER COMPLETION:**
RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** **CAVE OF BOREHOLE AT**

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION
A/E: FRENCH ASSOCIATES
PROJECT LOCATION: HARBOR BEACH, MICHIGAN
BY: RCT/JLN **DATE:** 1/15/02 **BORING B4**
CLIENT: HARBOR BEACH COMMUNITY SCHOOLS
PROJECT NUMBER: BG40743 **SHEET:** 1



WATER LEVEL OBSERVATIONS
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.

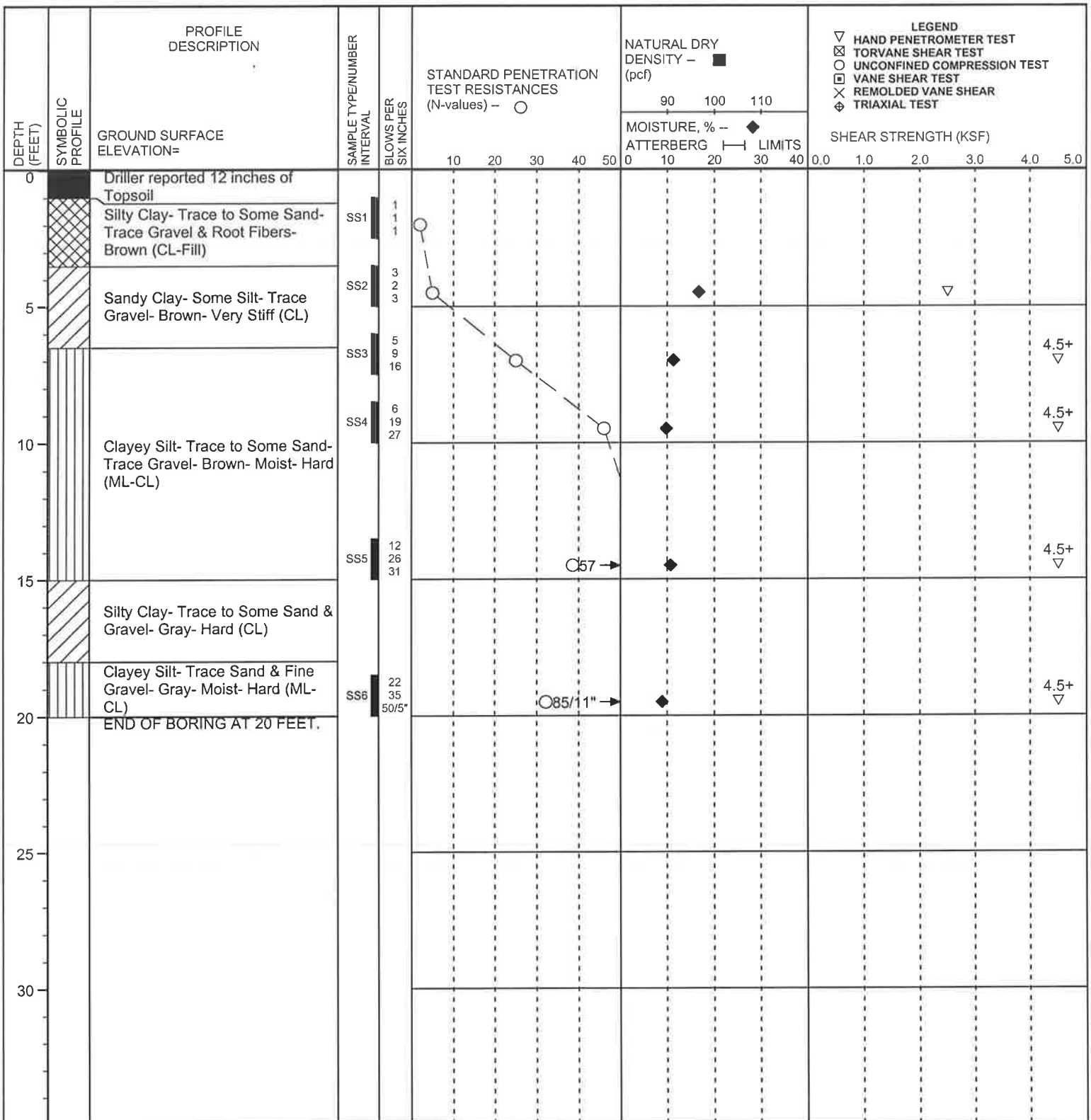
DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** 0 **WATER LEVEL** **HOURS AFTER COMPLETION:**
RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** **CAVE OF BOREHOLE AT**

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION **A/E:** FRENCH ASSOCIATES

PROJECT LOCATION: HARBOR BEACH, MICHIGAN **BY:** RCT/JLN **DATE:** 1/15/02 **BORING B5**

CLIENT: HARBOR BEACH COMMUNITY SCHOOLS **PROJECT NUMBER:** BG40743 **SHEET:** 1



WATER LEVEL OBSERVATIONS
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

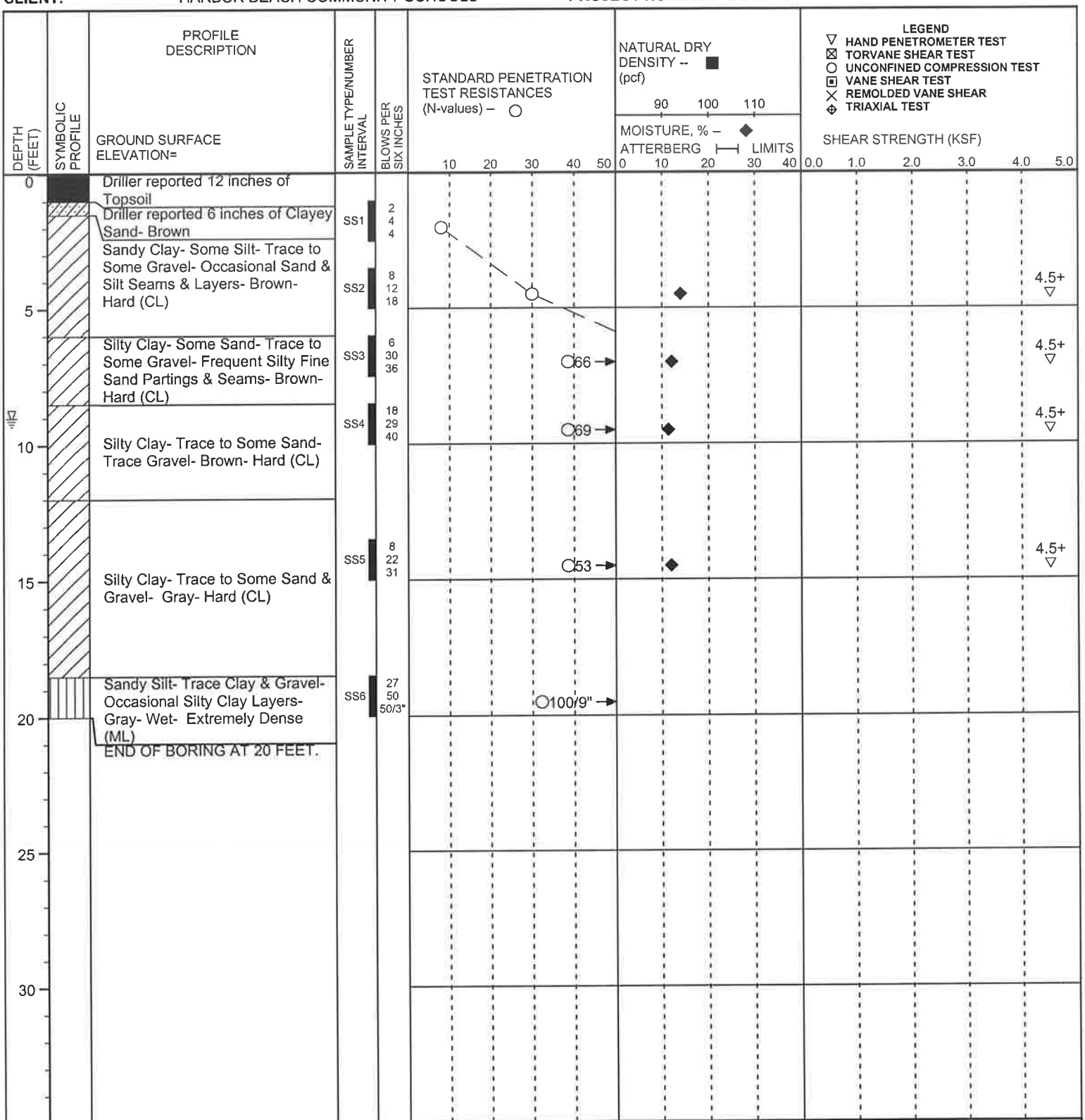
Notes:
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. GROUNDWATER WAS NOT ENCOUNTERED.
3. SOIL BORING OFFSET 15 FEET NORTH & 4 FEET EAST OF DESIRED LOCATION DUE TO WET/SOFT SURFACE CONDITIONS.

DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** **WATER LEVEL** **HOURS AFTER COMPLETION:**

RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** **CAVE OF BOREHOLE AT**

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION
A/E: FRENCH ASSOCIATES
PROJECT LOCATION: HARBOR BEACH, MICHIGAN
BY: RCT/JLN **DATE:** 1/14/02 **BORING B6**
CLIENT: HARBOR BEACH COMMUNITY SCHOOLS
PROJECT NUMBER: BG40743 **SHEET:** 1



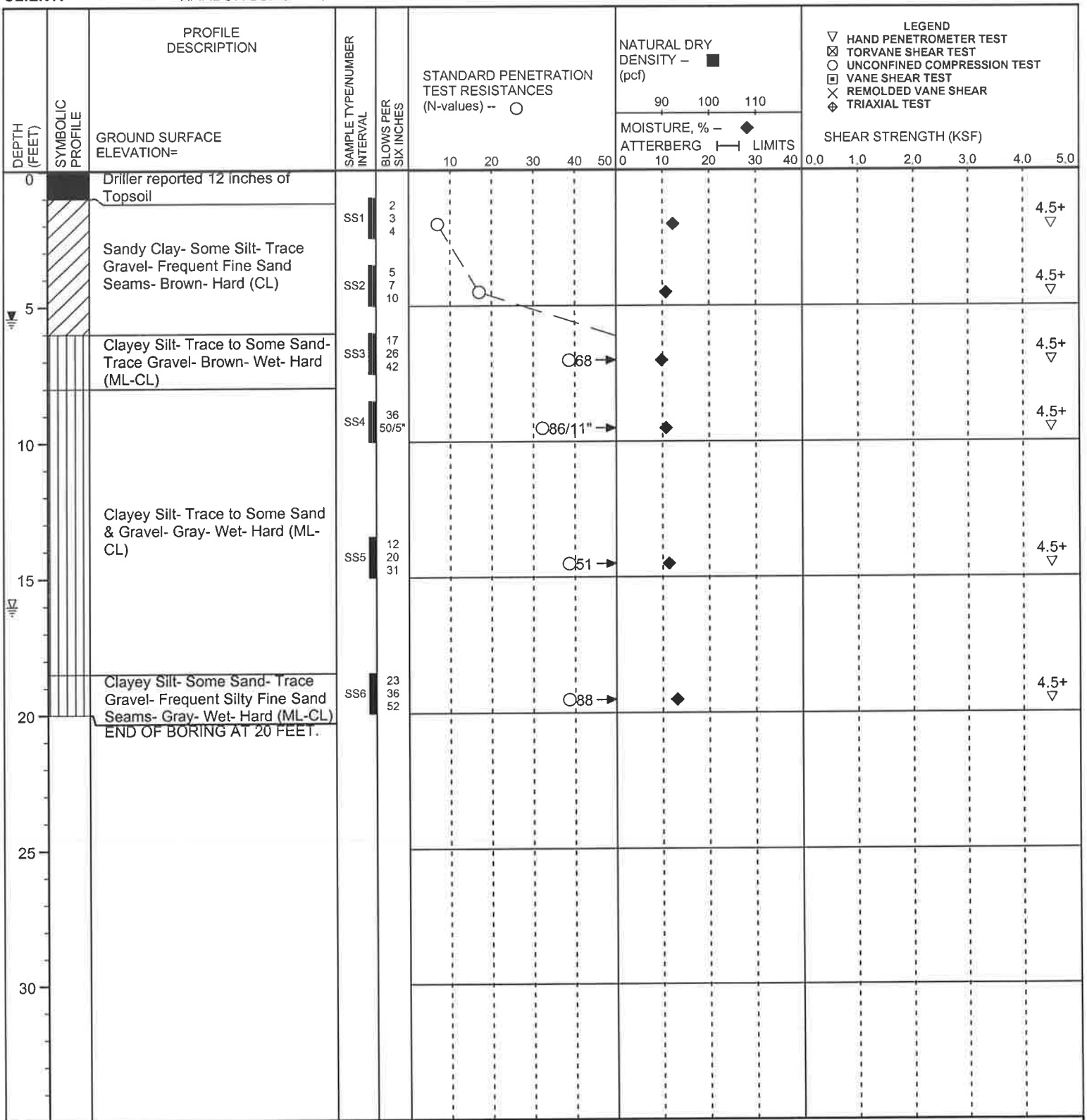
WATER LEVEL OBSERVATIONS
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.

DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** **WATER LEVEL** **HOURS AFTER COMPLETION:**
RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** 9 **CAVE OF BOREHOLE AT**

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION
A/E: FRENCH ASSOCIATES
PROJECT LOCATION: HARBOR BEACH, MICHIGAN
BY: RCT/JLN **DATE:** 1/15/02 **BORING B7**
CLIENT: HARBOR BEACH COMMUNITY SCHOOLS
PROJECT NUMBER: BG40743 **SHEET:** 1



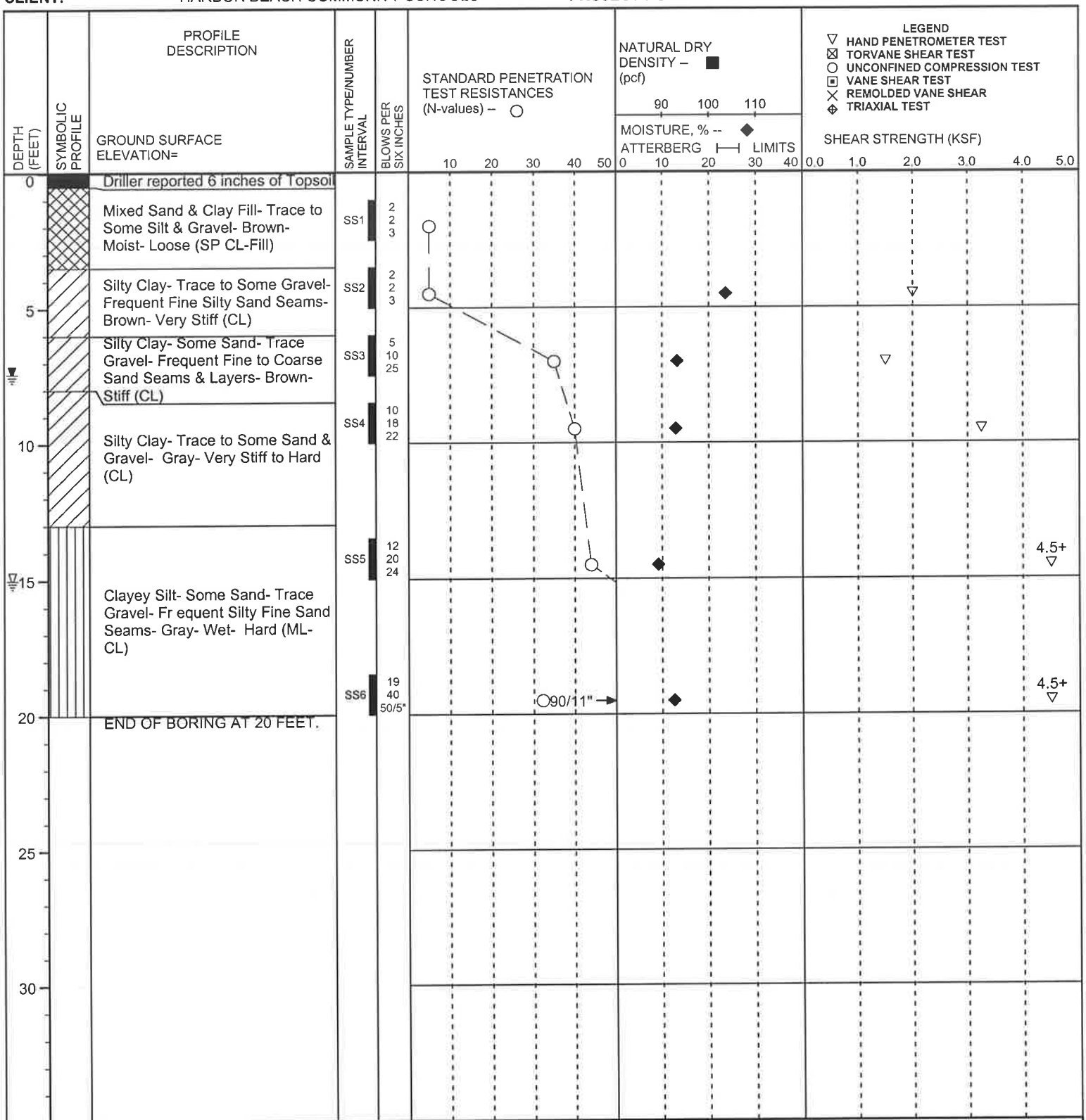
WATER LEVEL OBSERVATIONS
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.

DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** 5.42 **WATER LEVEL**
RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** 16 **CAVE OF BOREHOLE AT**
HOURS AFTER COMPLETION:

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION
A/E: FRENCH ASSOCIATES
PROJECT LOCATION: HARBOR BEACH, MICHIGAN
BY: RCT/JLN **DATE:** 1/15/02 **BORING B8**
CLIENT: HARBOR BEACH COMMUNITY SCHOOLS
PROJECT NUMBER: BG40743 **SHEET:** 1



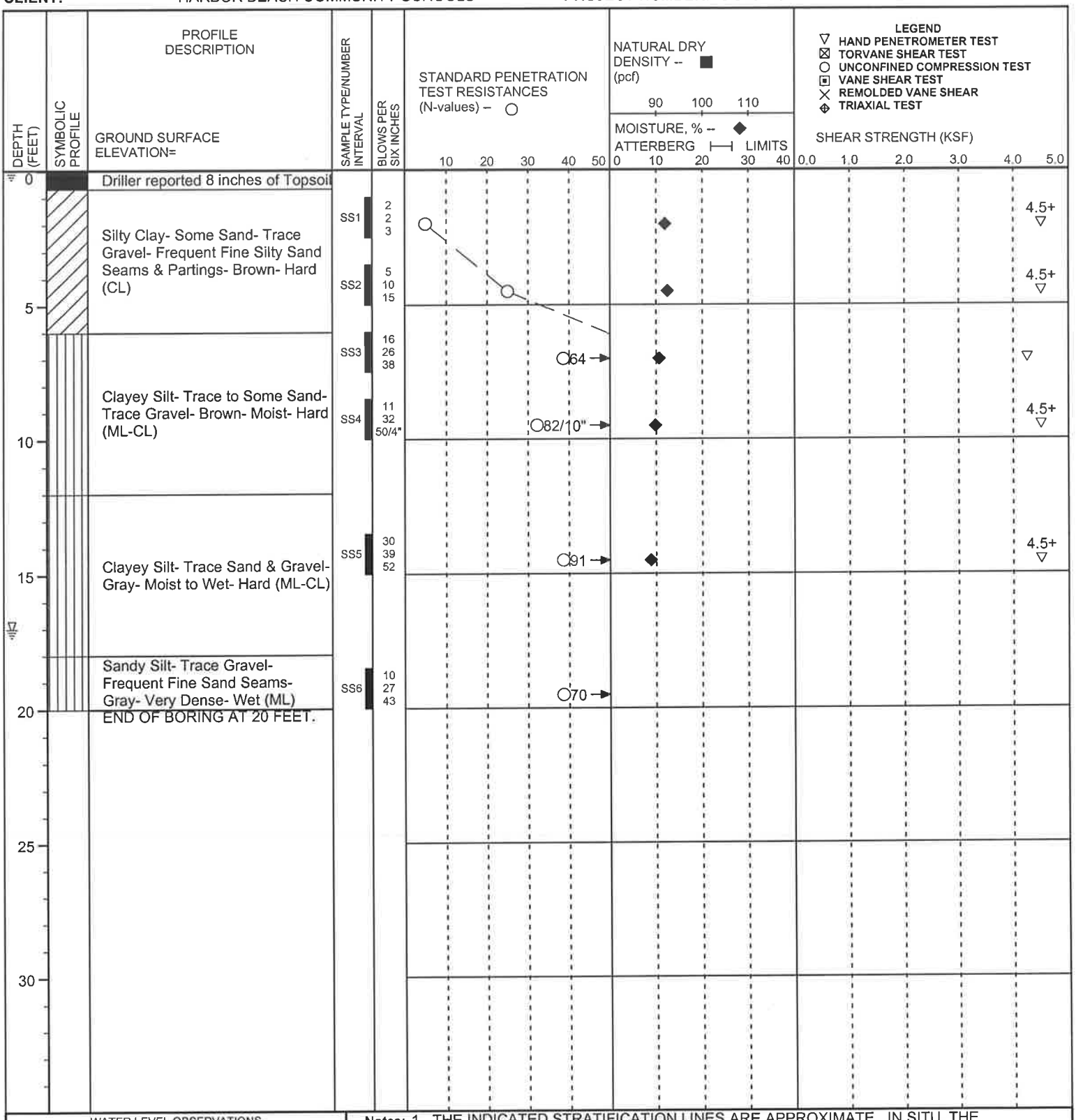
WATER LEVEL OBSERVATIONS
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.

DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** 7.42 **WATER LEVEL** **HOURS AFTER COMPLETION:**
RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** 15 **CAVE OF BOREHOLE AT**

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION
A/E: FRENCH ASSOCIATES
PROJECT LOCATION: HARBOR BEACH, MICHIGAN
BY: RCT/JLN **DATE:** 1/14/02 **BORING B9**
CLIENT: HARBOR BEACH COMMUNITY SCHOOLS
PROJECT NUMBER: BG40743 **SHEET:** 1



WATER LEVEL OBSERVATIONS
▼ GROUNDWATER ENCOUNTERED DURING DRILLING
▽ GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.

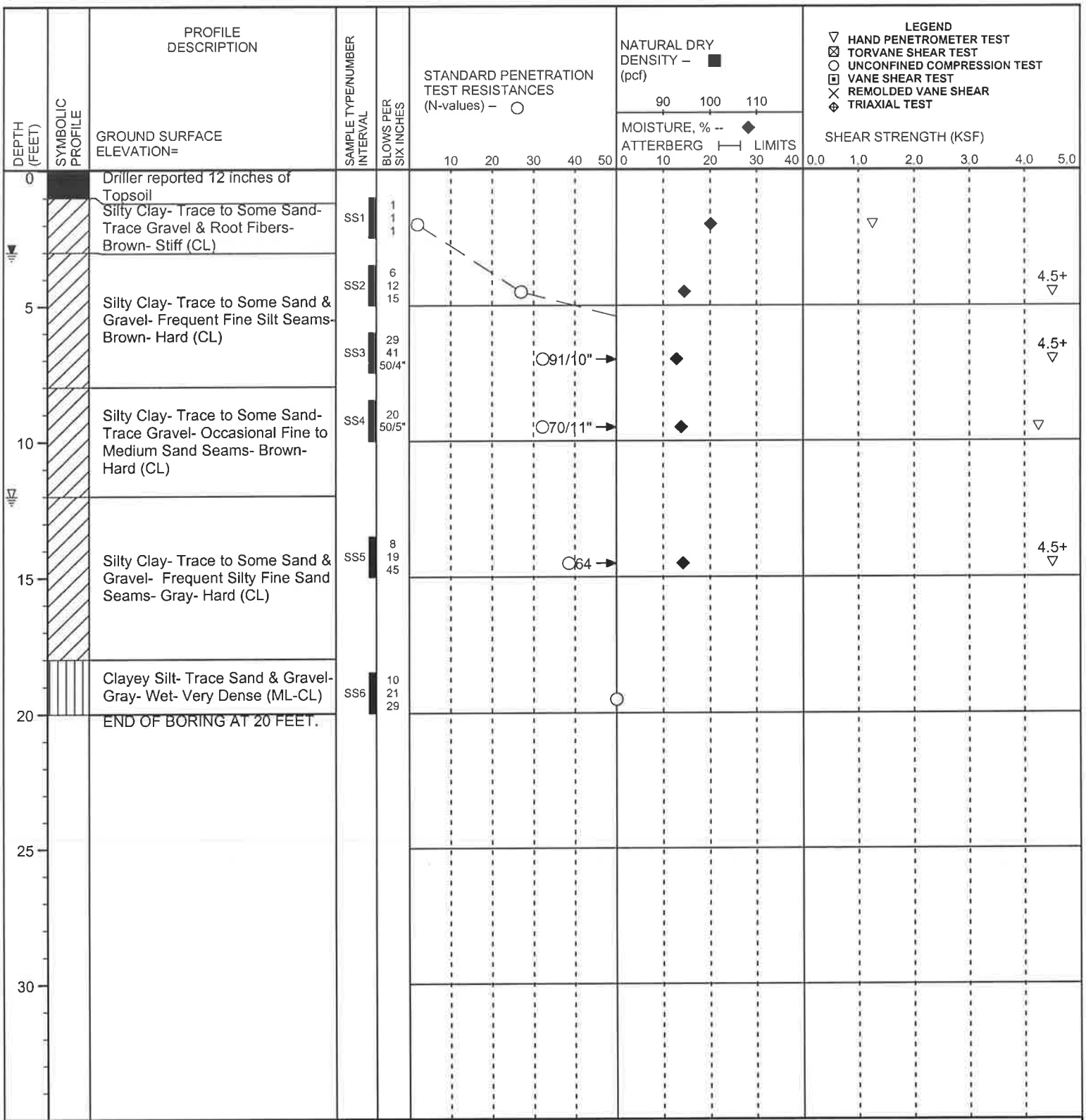
DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** 0 **WATER LEVEL HOURS AFTER COMPLETION:**
RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** 17 **CAVE OF BOREHOLE AT**

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION **A/E:** FRENCH ASSOCIATES

PROJECT LOCATION: HARBOR BEACH, MICHIGAN **BY:** RCT/JLN **DATE:** 1/14/02 **BORING B10**

CLIENT: HARBOR BEACH COMMUNITY SCHOOLS **PROJECT NUMBER:** BG40743 **SHEET:** 1



WATER LEVEL OBSERVATIONS

GROUNDWATER ENCOUNTERED DURING DRILLING

GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.

DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** 3 **WATER LEVEL** **HOURS AFTER COMPLETION:**

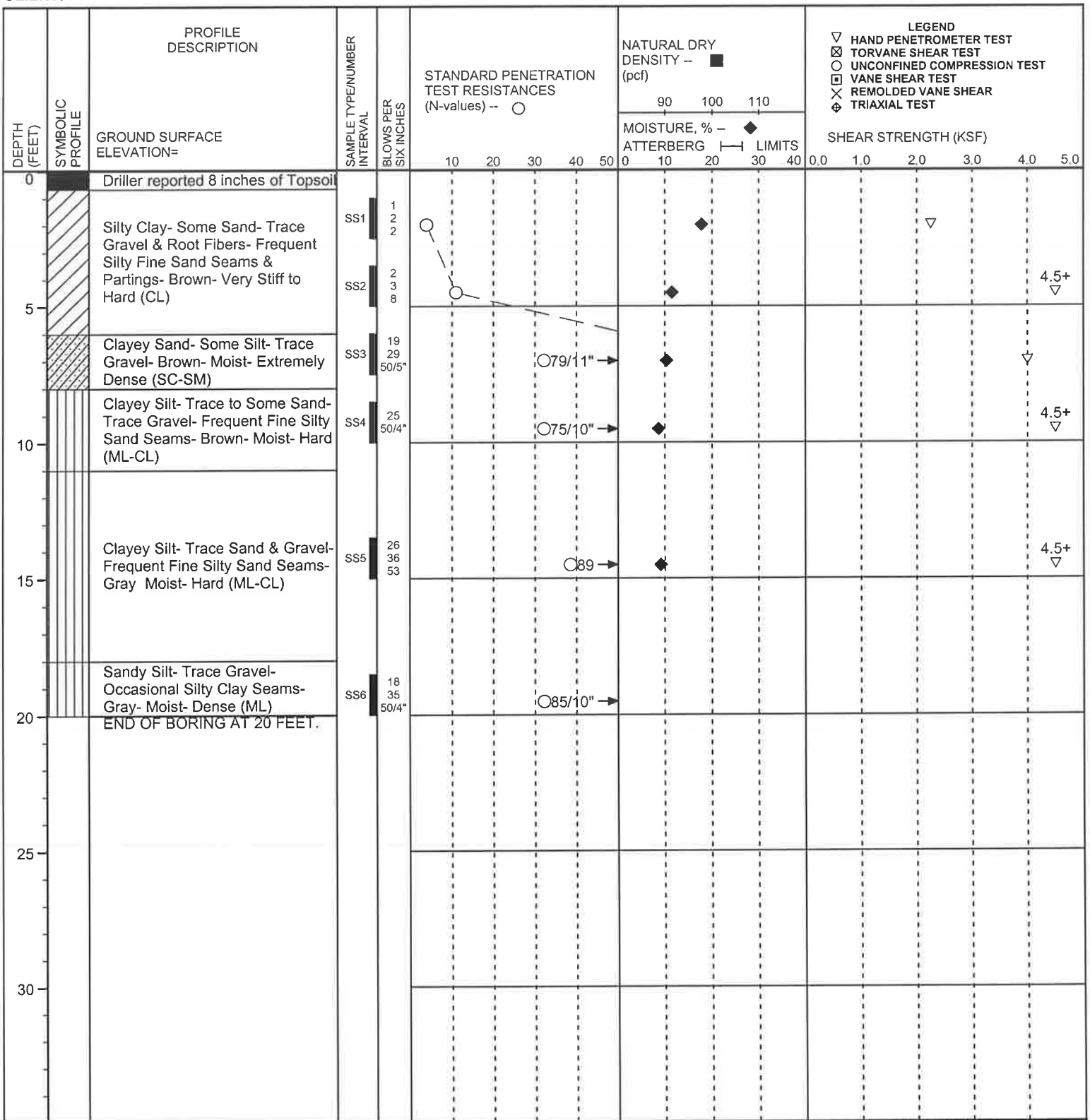
RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** 12 **CAVE OF BOREHOLE AT**

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION **A/E:** FRENCH ASSOCIATES

PROJECT LOCATION: HARBOR BEACH, MICHIGAN **BY:** RCT/JLN **DATE:** 1/14/02 **BORING B11**

CLIENT: HARBOR BEACH COMMUNITY SCHOOLS **PROJECT NUMBER:** BG40743 **SHEET:** 1



WATER LEVEL OBSERVATIONS
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

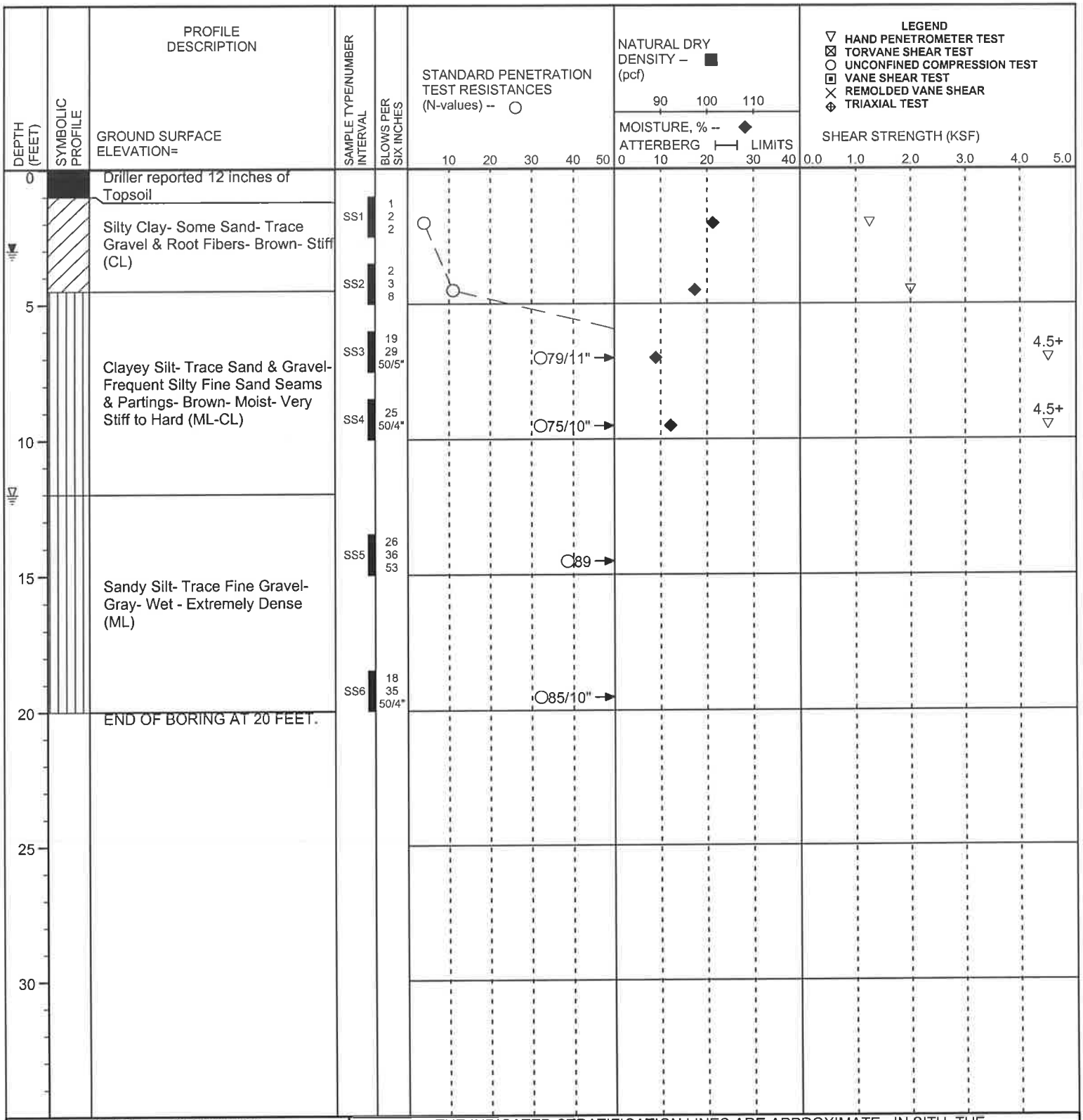
Notes: 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. GROUNDWATER WAS NOT ENCOUNTERED.

DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** **WATER LEVEL** **HOURS AFTER COMPLETION:**

RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** **CAVE OF BOREHOLE AT**

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION
A/E: FRENCH ASSOCIATES
PROJECT LOCATION: HARBOR BEACH, MICHIGAN
BY: RCT/JLN **DATE:** 1/14/02 **BORING B12**
CLIENT: HARBOR BEACH COMMUNITY SCHOOLS
PROJECT NUMBER: BG40743 **SHEET:** 1



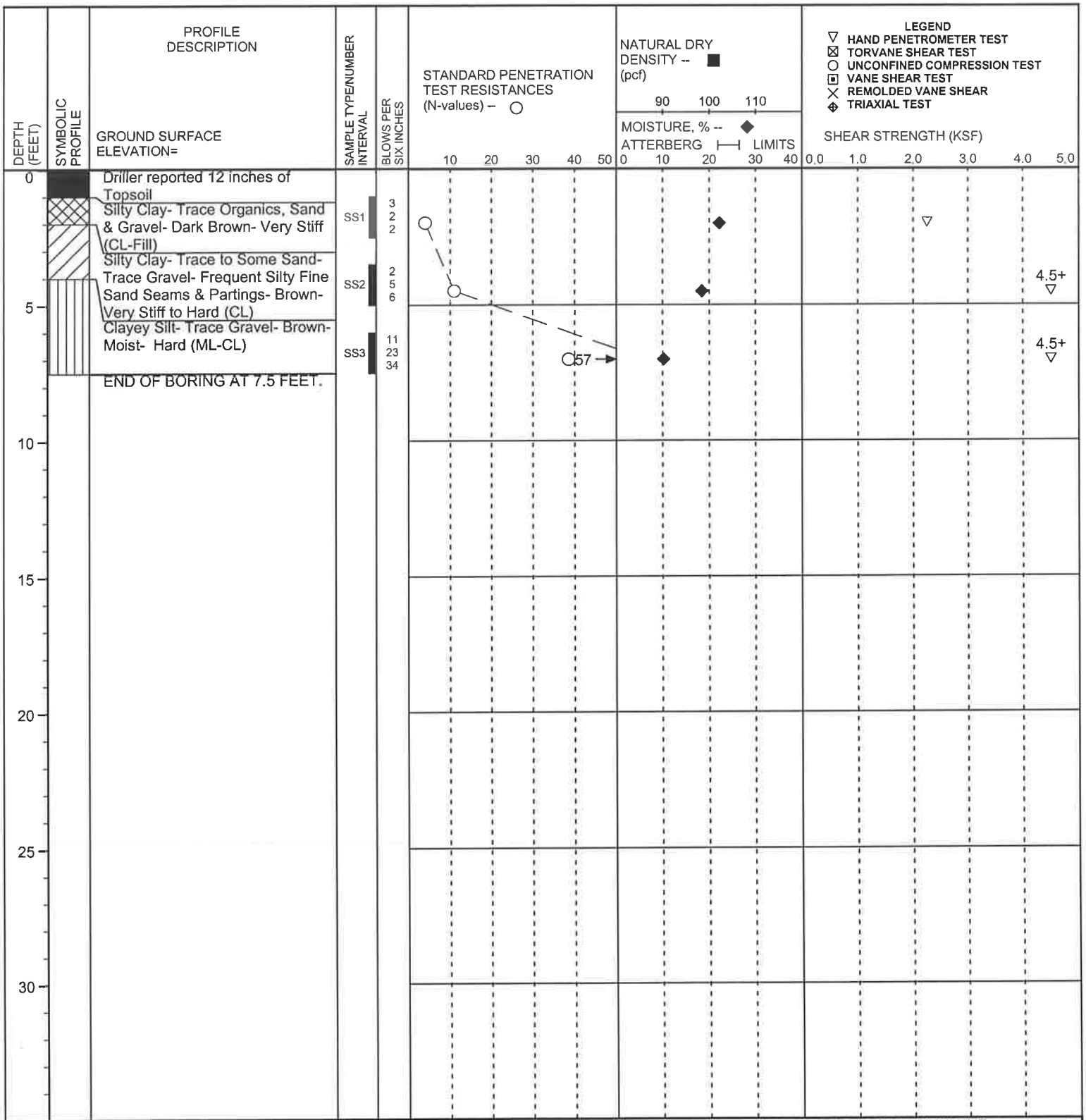
WATER LEVEL OBSERVATIONS
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.

DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** 3 **WATER LEVEL HOURS AFTER COMPLETION:**
RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** 12 **CAVE OF BOREHOLE AT**

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION
A/E: FRENCH ASSOCIATES
PROJECT LOCATION: HARBOR BEACH, MICHIGAN
BY: RCT/JLN **DATE:** 1/13/02 **BORING B13**
CLIENT: HARBOR BEACH COMMUNITY SCHOOLS
PROJECT NUMBER: BG40743 **SHEET:** 1



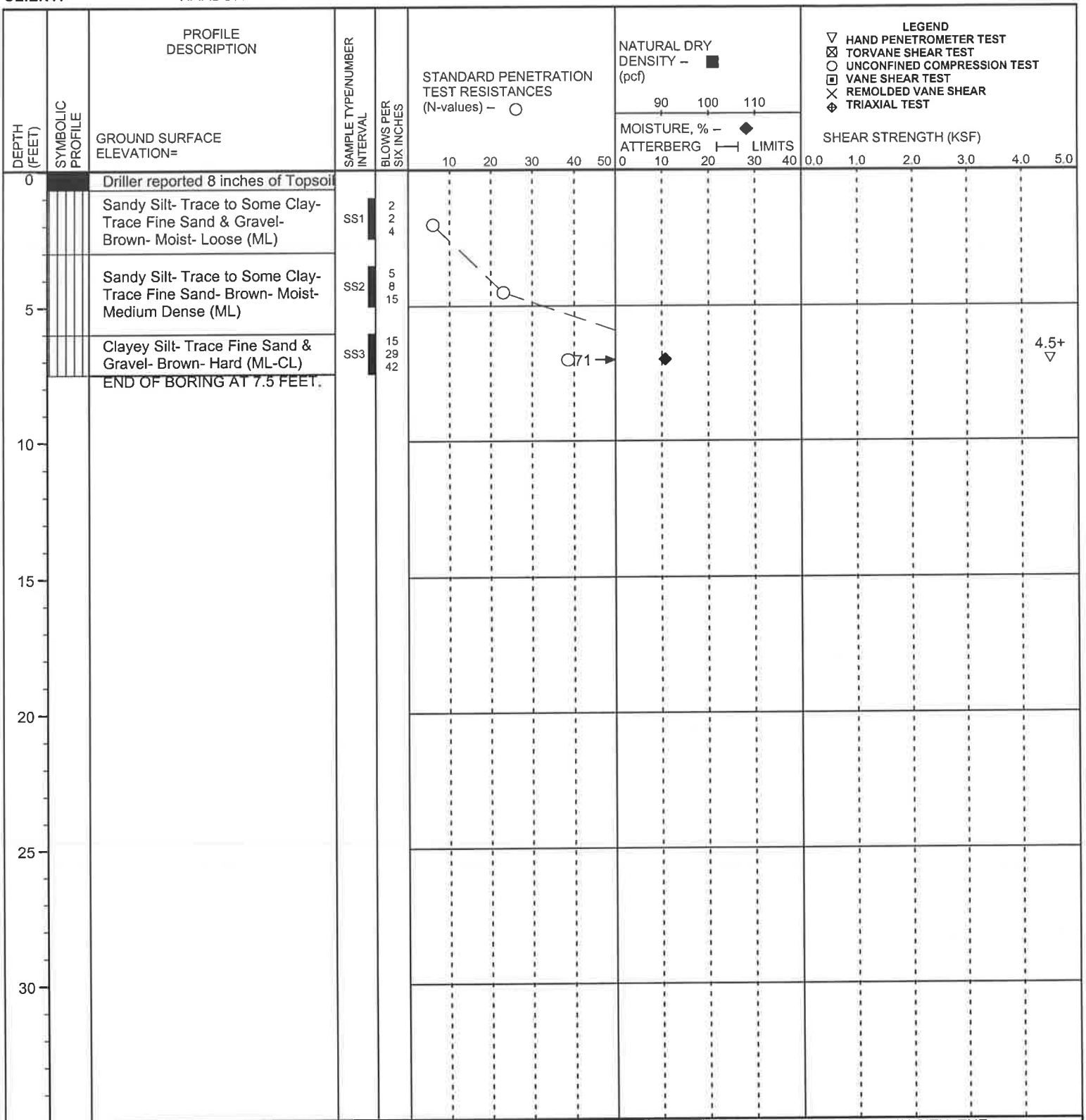
WATER LEVEL OBSERVATIONS
GROUNDWATER ENCOUNTERED DURING DRILLING
GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes:
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. GROUNDWATER WAS NOT ENCOUNTERED.
3. SOIL BORING OFFSET 18 FEET SOUTH OF DESIRED LOCATED DUE TO EXISTING WATERLINE.

DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** **WATER LEVEL** **HOURS AFTER COMPLETION:**
RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** **CAVE OF BOREHOLE AT**

soil and materials engineers, inc.

PROJECT NAME: HARBOR BEACH SCHOOL ADDITION
A/E: FRENCH ASSOCIATES
PROJECT LOCATION: HARBOR BEACH, MICHIGAN
BY: RCT/JLN **DATE:** 1/13/02 **BORING B14**
CLIENT: HARBOR BEACH COMMUNITY SCHOOLS
PROJECT NUMBER: BG40743 **SHEET:** 1



WATER LEVEL OBSERVATIONS
▼ GROUNDWATER ENCOUNTERED DURING DRILLING
▼ GROUNDWATER ENCOUNTERED UPON COMPLETION OF DRILLING

Notes: 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE. IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. GROUNDWATER WAS NOT ENCOUNTERED.
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DRILLER: JB **DRILL METHOD:** Solid-stem Augers **WATER LEVEL DURING DRILLING:** **WATER LEVEL** **HOURS AFTER COMPLETION:**
RIG NO.: 34 **BACKFILL METHOD:** Auger Cuttings **WATER LEVEL UPON COMPLETION:** **CAVE OF BOREHOLE AT**

SECTION 012300
ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

1. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

1. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

    1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
    2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

1. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

    1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

2. Execute accepted alternates under the same conditions as other work of the Contract.

3. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

1. Alternate No. 1: Science Lab Countertop Refinishing

    1. Base Bid: No modifications to existing countertops.
    2. Add Alternate: Refinish Existing Lab Countertops in Room Science [H121].

2. Alternate No. 2: Flooring Installation, Moisture Mitigation

    1. Base Bid: NA
    2. Add Alternate: Provide SF Cost for moisture mitigation in preparation for flooring installation following ASTM F3010 (Standard Practice for Two Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings)

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

F. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Inventory and record the condition of items to be removed and salvaged.

2.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    c. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    d. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

2.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

C. Remove temporary barricades and protections where hazards no longer exist.

2.4 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
4. Maintain fire watch during and for at least 1 hours after flame-cutting operations.

5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
6. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner .
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

2.5 CLEANING

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

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

END OF SECTION 024119

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SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

1.2 REFERENCES

A. ACI 301 Specifications for Structural Concrete for Buildings.
B. ACI 305 Hot Weather Concreting.
C. ACI 306.1 Standard Specification for Cold Weather Concreting.
D. ACI 318 Building Code Requirements for Reinforced Concrete.
E. ANSI/ASTM A185 Welded Wire Fabric for Concrete Reinforcement.
F. ASTM A615 Deformed and Plain Billet Steel for Concrete Reinforcement.
G. ASTM C33 Concrete Aggregates.
H. ASTM C94 Ready Mixed Concrete.
I. ASTM C150 Portland Cement.
J. ASTM C260 Air Entraining Admixtures for Concrete.
K. ASTM C309 Liquid Membrane Forming Compounds for Curing Concrete.
L. ASTM D2103 Polyethylene Film and Sheeting.

1.3 RELATED SECTIONS

A. Section 042200- Masonry: rebar dowels, embedded in foundations, to match masonry wall rebar.
B. Section 051200- Structural Steel: Anchor bolts, embedded in foundations, bearing plates attached to form work.
C. Section 076200- Sheet Metal Flashing and Trim: Flashing reglets attached to formwork.

1.4 ACTION SUBMITTALS

A. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure and as approved by the Architect.
2. Submit shop drawings of reinforcing steel to Architect for approval prior to fabrication. Submit under provisions established by Construction Manager.
3. Indicate reinforcement sizes, spacings, locations and quantities of reinforcing steel, bending and cutting schedules, and splices.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Vapor retarders.
4. Joint-filler strips.

B. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Aggregates.
4. Admixtures:

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301, ACI 305, ACI 306.1, and ACI 318.
B. Maintain copies of ACI 301, 305, 306.1, and 318 on site.
C. In the ACI publications, consider advisory provisions mandatory, as though the word “shall” had been substituted for “should” wherever “should” appears.
D. For conflicts in the provisions of the ACI publications, ACI 301 shall govern. For any conflicts between the ACI publications and this specification, this specification shall govern.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.8 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

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

2.2 FORM MATERIALS

A. Conform to ACI 301.
B. Plywood forms: APA B-B Plyform Class I sound undamaged sheets.
C. Lumber: spruce-pine-fir #2 or better; with grade stamp clearly visible.
D. Steel Forms: Minimum thickness to support weight of concrete with minimum deflection.
E. Form Ties: removable or snap-off metal, of fixed or adjustable length.

2.3 REINFORCING STEEL

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade billet steel deformed bars, uncoated finish.
B. Welded Wire Fabric: Plain type, ANSI/ASTM A185; in flat sheets; uncoated finish.

2.4 CONCRETE MATERIALS

A. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C33/C33M, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.
C. Water and Water Used to Make Ice: ASTM C94/C94M, potable

2.5 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; thickness as indicated on drawings. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.6 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
3. Total of Fly Ash or Other Pozzolans: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use admixture in concrete, as required, for placement and workability.

D. **WVRA**: ASTM C 494/C 494M, Type S; complex catalyzed hydrous silicate, water and vapor proofing liquid admixture.

1. Basis-of-Design Product: Subject to compliance with requirements, provide, Specialty Products Group; Vapor Lock 20/20™ or comparable product by one of the following:
   a. Concure.
   b. Moxie International.

2. Properties:
   a. W/C Ratio: Maximum 0.52 without written permission and approval of mix design by WVRA manufacturer.
   b. W/C Ratio: Minimum 0.42 without written permission and approval of mix design by WVRA manufacturer.
   c. Water Seepage or Permeability: Not to exceed 2.0 x 10-9 ft/s (6 x 10-8 cm/s) according to ASTM D 5084.
   d. Internal Wet Curing: Additional curing is unnecessary when using WVRA admixtures, except during hot or cold weather concreting conditions; follow ACI 306.1 and ACI 301

3. Warranty:
   a. Design mixture containing a WVRA must be approved in writing by WVRA manufacturer.
   b. Installer shall be WVRA certified.
   c. Cylinder Testing: Testing agency or WVRA manufacturer to obtain concrete cylinder from mockup and test at testing agency specified by WVRA manufacturer according to ASTM D 5084. Cost of test shall be borne by WVRA manufacturer.
   d. Manufacturer's Warranty: WVRA admixture manufacturer agrees to repair, replace or re-apply damaged floor covering or

adhesive, surface treatment, coating or paint materials that fail within specified warranty period.

(1) Failures include, but are not limited to, proven claims made on any floor covering or adhesive, surface treatment, coating or paint that sustains damage due to moisture vapor migration or alkali efflorescence attack, which had migrated through concrete, and includes blistering, peeling, leakage, seepage, or absorption of moisture, petroleum, sulfides, or acids.

(2) Warranty does not apply to, or cover, the following:

(a) Water vapor migration moving laterally under a floor covering originating from external sources such as drains or broken pipes.

(b) Structural cracks or damage or conditions caused by neglect, abuse, acts of God or nature; other materials and/or conditions resulting from inferior application or workmanship or design, whether intentional or not; or situations beyond its control.

(c) Liquidated, incidental and/or consequential damages or for contribution or indemnity.

(3) Material Warranty Period: 10 years from date of Substantial Completion

(4) Third-Party Labor and Material Insurance:

(5) Liability insurance purchased by WVRA manufacturer (the first party) from a legitimate insurer (the second party) for protection against the claims of end-user and all stakeholders in Project (the third) party.

(a) Coverage Amount: $20 million dollars U.S.

4. Do not apply any Liquid Floor Treatment Applications to concrete that contains WVRA admixture. The addition of the WVRA removes all required Liquid Floor Treatment applications from construction documents.

5. Inspections: For concrete containing WVRA admixture provide the following:

a. Moisture Testing: Conducted by WVRA manufacturer or appointed representative prior to installation of moisture sensitive coatings and adhesives. No other moisture testing by installers is required.

b. Bond Testing: Conducted by WVRA manufacturer or appointed representative on moisture sensitive materials installed by Contractor.

c. Ph Testing: Conducted by WVRA manufacturer or appointed representative.

d. Report test results in writing to Architect and Contractor within 48 hours of testing.

e. Authorization to proceed with installation of moisture sensitive coatings and materials must be obtained in writing from WVRA manufacturer.

E. WVRA Testing: ASTM D 5084; 4- by 8-inch cylinder size obtained by WVRA manufacturer or appointed representative.

2.7 ACCESSORIES

A. Bonding Agent: ASTM C932.

B. Vapor Barrier: ASTM D2103, 6 mil thick clear polyethylene film.

C. Non-Shrink Grout: Premixed compound with non-metallic aggregate, cement, water reducing and plasticizing agents; capable of minimum compressive strength of 4000 psi.

D. Drilled in Concrete Anchors (DCA's). Provide stainless steel or galvanized to F185 coating per ASTM A153 for DCA's in contact with preservative treated wood.

E. Flashing Reglets: Galvanized steel; longest possible lengths; alignment splines for joints; securable to formwork.
F. Construction Joints: 2”x2” key, formed with prefabbed galvanized steel or wood forms.
G. Expansion Joints: ½” wide with bituminous impregnated fiberboard filler conform to ANSI/ASTM D994.
H. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

2.8 CURING MATERIALS

A. Water: Clean and drinkable.
B. Membrane Curing Compound: ASTM C309
C. Polyethelene Film: ASTM D2103, 4 mil thick, clear color.
D. **Sealer:** BASF Kure and Seal 30, or equal, at exposed concrete floor areas. Coordinate with architectural finish schedule.

2.9 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings, grade beams, and tie beams.

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Slump Limit: 4 inches, plus or minus 1 inch

B. Class B: Normal-weight concrete used for foundation and retaining walls.

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Slump Limit: 4 inches, plus or minus 1 inch

C. Class C: Normal-weight concrete used for interior slabs-on-ground.

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Slump Limit: 4 inches, plus or minus 1 inch

D. Class D: Normal-weight concrete used for interior suspended slabs.

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Slump Limit: 4 inches, plus or minus 1 inch

E. Class F: Normal-weight concrete used for concrete toppings.

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Slump Limit: 4 inches, plus or minus 1 inch.

F. Add air entraining agent to mix for all concrete except interior footings, interior walls, interior piers and interior slabs.

PART 3 - EXECUTION

3.1 FORMWORK EXECUTION

A. Verify lines, levels, and measurement before proceeding with formwork.
B. Hand trim sides and bottom of earth forms; remove loose dirt.
C. Align for joints.
D. Do not apply form release agent where concrete surfaces receive special finishes or applied coatings which may be affected by agent.

E. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts.

3.2 REINFORCEMENT

A. Place, supports, and secure reinforcement against displacement.
B. Locate reinforcing splices at points of minimum stress.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

3.5 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

a. Do not use vibrators to transport concrete inside forms.
b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

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

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
b. Remove projections larger than 1 inch.
c. Tie holes do not require patching.
d. Surface Tolerance: ACI 117 Class D.
e. Apply to concrete surfaces not exposed to public view.

2. ACI 301Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/4 inch.
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 Class B.
    e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

3.8 FINISHING FLOORS AND SLABS

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

B. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

C. Flatness and levelness tolerances for floor slabs shall be in accordance with ACI 117, section 4.5.6 and/or 4.5.7.

1. All areas, except as described in b. or c., below, or unless noted otherwise, shall conform to ACI 117 “conventional straightedged “construction, i.e., 5/16” in ten feet or F_F=20 & F_L=15 for the “F” number method.
2. For slabs intended to support a synthetic or hardwood gym floor, use “very flat” construction per ACI 117, i.e., 1/8” in 10 feet or F_F=50 & F_L=30 for the “F” number method.
3. For slabs intended to be finished with cork tile, use “flat” construction per ACI 117, i.e., 3/16” in 10 feet or F_F=30 & F_L=20 for the “F” number method.

D. Pitch to drains at 1/8” per foot nominal. Refer to plumbing plans for drain locations.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

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

B. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Minimum Compressive Strength: 4000 psi at 28 days.

C. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

3.10 TOLERANCES

A. Conform to ACI 117.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

1) Project name.
2) Name of testing agency.
3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
4) Name of concrete manufacturer.
5) Date and time of inspection, sampling, and field testing.
6) Date and time of concrete placement.
7) Location in Work of concrete represented by samples.
8) Date and time sample was obtained.
9) Truck and batch ticket numbers.
10) Design compressive strength at 28 days.
11) Concrete mixture designation, proportions, and materials.
12) Field test results.
13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
14) Type of fracture and compressive break strengths at seven days and 28 days.

B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength,

aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.
6. Batch Plant Inspections: On a random basis, as determined by Architect.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Three concrete test cylinders will be taken for every 150 or less cubic yards of each class of concrete placed each day.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

3. Slump Flow: ASTM C1611/C1611M:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C1064/C1064M:

    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Compression Test Specimens: ASTM C31/C31M:

a. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
b. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C39/C39M.

a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests:

a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.

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

3.12 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.

7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION

SECTION 042200
CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Clay face brick.
3. Concrete face brick.
4. Steel reinforcing bars.

1.2 RELATED SECTIONS

A. Section 033000- Cast-in-place Concrete: Placement of reinforcing bars.
B. Section 079200- Joint Sealers: rod and sealant at control and expansion joints.

1.3 REFERENCES

A. ACI 530/ASCE 5/TMS 402 Building Code Requirements for Masonry Structures.
B. ACI 530.1/ASCE 6/TMS 602 Specifications for Masonry Structures.
C. ANSI/ASTM A82 Cold Drawn Steel Wire for Concrete Reinforcement.
D. ANSI/ASTM C216 Facing Brick(Solid Masonry Units Made From Clay or Shale).
E. ASTM A307 Carbon Steel Externally Threaded Standard Fasteners.
F. ASTM C67-Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
G. ASTM C90 Load Bearing Concrete Masonry Units.
H. ASTM C91 Masonry Cement
I. ASTM C94 Ready Mixed Concrete
J. ASTM C144 Aggregate for Masonry Mortar
K. ASTM C150 Portland Cement
L. ASTM C207 Hydrated Lime for Masonry Purposes
M. ASTM C270 Mortar for Unit Masonry
N. ASTM C387 Packaged, Dry, Combined Materials, for Mortar and Concrete
O. ASTM C404 Aggregates for Masonry Grout
P. ASTM C476 Grout for Masonry IMIAWC International Masonry Industry All Weather Council: Recommended Practices and Guide Specifications for Clod Weather Masonry Construction

1.4 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).
B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
B. Samples: For each type and color of the following:

1. Face brick
2. Colored-aggregate mortar.

1.6 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product. For masonry units, include data on material properties material test reports substantiating compliance with requirements.

1.7 QUALITY ASSURANCE

A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for each type of exposed unit masonry construction, typical exterior wall, typical interior wall, typical exterior and interior walls in sizes approximately 16 inches long by 24 inches high**.**

1.8 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1.9 EFFLORESCENCE

A. Samples of veneer for exterior walls will be tested for effloresence per ASTM C67 prior to acceptance of veneer. The samples shall be taken directly from the pallets delivered to the site, at the rate of one sample per 5000 units.
B. In the event that efflorescence appears after walls are in place, the Architect shall select samples of veneer and mortar taken directly from the wall to be tested for chemical content. If efflorescence producing materials are found in the veneer or mortar in amounts exceeding the limits called for by this specification and the referenced ASTM standards, the contractor shall bear the cost of the testing and remedial work on the masonry. If efflorescence producing materials in both the veneer and the mortar do not exceed the limits as stated above, the cost of the testing and patching the areas where samples were removed shall be by Owner.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.

C. CMUs: ASTM C90.

1. Masonry for the load-bearing wythe of all load-bearing walls and all exterior walls shall have a masonry compressive strength, f'm, of 2500 psi
2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3750 psi for load-bearing walls, and 1900 psi for all other walls.
3. Density Classification: Normal weight.

2.3 FACE BRICK

A. Face Brick: ANSI/ASTM C216, Type FBS, Grade SW; color as follows:
   a. **Field Brick:** Bowerston Brick 50% Autumn Clear wc + 30% Autumn Rose Clear w + 20% Sunset Clear wc – Standard modular size.
   b. **Infill Brick:** Belden Brick Concord Blend – Standard modular size.
   c. **Burnished Block Accent**: Grand Blanc Cement Products Ralph Yates – Color Great White.

2. The saturation coefficient requirement of ANSI/ASTM C216 shall not be waived.
3. Maximum water absorption shall not exceed 5% by weight of unit.
4. The initial rate of absorption shall not be less than 6 grams per minute nor more than 20 grams per minute.
5. The maximum permissible extent of chippage 0"-1/4" in from the edge and 0"-3/8" in from the corner shall not exceed 40%.
6. If cored units are supplied, three cores of 1-1/2"maximum diameter shall be the pattern provided.

B. Brick Masonry Units: Nominal modular size of 2-2/3" high x 8" long x 4" wide and nominal utility size 4" high x 12" long x 4" wide, or as indicated in specific brick selection. Provide special units for bull nosed corners.

2.4 CONCRETE LINTELS

A. Concrete Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I, gray color.
B. Hydrated Lime: ASTM C207, Type S.
C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
D. Masonry Cement: ASTM C91/C91M, Type S.
E. Aggregate for Mortar: ASTM C144, Standard masonry type.

1. White-Mortar Aggregates: Natural white sand or crushed white stone.

2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

F. Aggregate for Grout: ASTM C404.
G. Cold-Weather Admixture: Non-chloride, non-corrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
I. Water: Clean and Potable.

2.6 REINFORCEMENT AND ANCHORAGE

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.
B. Masonry-Joint Reinforcement, General: ASTM A951/A951M.

1. Interior Walls: Mill- galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 9 gauge (0.148-inch) diameter.
4. Wire Size for Cross Rods: 9 gauge (0.148-inch) diameter.
5. Spacing of Cross Rods: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
7. Cavity Walls: Standard hook and eye adjustable anchors.
8. Strap Anchors: Bent steel shape, one inch wide x 3/16" thick.
9. Dovetail Anchors: Bent steel strap, galvanized finish, 24 gauge with 12 gauge wire triangles.
10. Built-in Anchors: ASTM A307.
11. Reinforcing Steel: Deformed type, specified in Section 03001; uncoated finish.

C. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
3. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

D. Partition Top Anchors: 0.105-inch- thick metal plate with a 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

1. Corrosion Protection: Unless otherwise required, protect joint reinforcement, ties and anchors from corrosion by galvanizing in conformance with Sections 1.13.4.3 of ACI 530/ASCE 5/TMS 402 and Section 2.4 F of ACI 530.1/ASCE 6/TMS 602.

F. All intersecting masonry walls (load and nonloadbearing) shall be anchored or bonded together by one of the methods described in the 2015 Michigan Building Code, unless noted otherwise. Masonry walls intersecting a perpendicular wall of a different material shall be anchored to that wall by means of steel connectors per 2015 Michigan Building Code, unless noted otherwise.
G. Interior nonloadbearing masonry walls, with an unsupported length between intersecting perpendicular walls greater than 36 times the wall thickness, shall be braced to the floor or roof structure above at intervals not exceeding 36 times the wall thickness, unless noted otherwise.

2.7 FLASHING

A. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
B. Drilled in Concrete Anchors (DCA's) for grouted masonry. Provide stainless steel or galvanized to G185 coating per ASTM A153 for DCA's in contact with preservative treated wood.
C. Drilled in Concrete Anchors (DCA's) for hollow masonry. Provide stainless steel or galvanized to G185 coating per ASTM A153 for DCA's in contact with preservative treated wood.
D. Cavity Wall Drainage: Mortar Net, or equal with head joint cell vent as indicated on architectural drawings.
E. Control Joints: Form with preformed rubber or PVC joint devices.

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime or masonry cement mortar.
4. For reinforced masonry, use portland cement-lime or masonry cement mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
4. For interior nonload-bearing partitions, Type O may be used instead of Type N.

D. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:

a. Face Brick

E. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 10 inches as measured according to ASTM C143/C143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.2 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.

3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
F. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
C. Provide continuity at wall intersections by using prefabricated T-shaped units.
D. Provide continuity at corners by using prefabricated L-shaped units.

3.6 FLASHING

A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.
B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels, extend flashing a minimum of 8 inches into masonry at each end. At heads and sills, extend flashing 8 inches at ends and turn up not less than 2 inches to form end dams.
3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

3.7 WEEPS

A. Provide weep holes at 24” on center horizontally above through-wall flashing and at bottom of walls.
B. Weep holes and cavity vents shall consist of un-mortared, open head joints with honeycomb type inserts.
C. The weep hole shall extend through the lowest bed joint to the top side of the through-wall flashing.
D. Provide cavity vents at the top of each cavity space at 48” on center horizontally.

3.8 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

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

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.9 FIELD QUALITY CONTROL

A. Reference structural drawings for additional Special Inspection requirements as designated per Chapter 17 of the Michigan Building Code.
B. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Owners expense.
C. Inspections: Special inspections according to Level C in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

D. Testing Prior to Construction: One set of tests.
E. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.
G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.
H. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for compressive strength.
I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.
J. Prism Test: For each type of construction provided, according to ASTM C1314 at 28 days.

3.10 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

END OF SECTION

SECTION 051200
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes structural steel framing members, base and bearing plates; anchor bolts for structural steel; beams, girders, columns, posts; connecting materials for framing structural steel; fasteners for connecting structural steel items; lintels; and grouting under base plates.
B. Related Sections:

1. Section 052100 – Steel Joist Framing
2. Section 053100 – Steel Decking
3. Section 055000 – Metal Fabrications

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 REFERENCES

A. AISC (American Institute of Steel Construction) - Specification for Structural Steel Buildings, Allowable Stress Design (ASD).
B. AISC (American Institute of Steel Construction) - Code of Standard Practice for Structural Steel Buildings and Bridges.
C. ASTM A36/A36M - Carbon Structural Steel.
D. ASTM A53 Hot Dipped, Zinc coated Welded and Seamless Steel Pipe.
E. ASTM A325 - Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength.
F. ASTM A490 - Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength.
G. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
H. ASTM A992 – Standard Specification for Structural Steel Shapes.
I. ASTM F1554-Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength
J. AWS A2.4 (American Welding Society) - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
K. AWS D1.1 (American Welding Society) - Structural Welding Code - Steel.
L. RCSC (Research Council on Structural Connections) - Specification for Structural Joints Using ASTM A325 or A490 Bolts, LRFD or ASD.
M. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual, Volumes 1 and 2.
N. UL (Underwriters Laboratory, Inc.) - Fire Resistance Directory.

1.4 SUBMITTALS

A. Division 1 – Submittals procedures: Submittal requirements.
B. Shop Drawings:

1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
2. Connections.
3. Cambers. And shear connectors.

4. Indicate welded connections with AWS A2.4 welding symbols. Indicate weld lengths.

C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC Code of Standard Practice.
B. Perform Work in accordance with AISC Code of Standard Practice, Section 10.
C. Maintain one copy of each document on site.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M.
B. Channels, Angles-Shapes: ASTM A36/A36M.
C. Plate and Bar: ASTM A36/A36M.
D. Cold-Formed Hollow Structural Sections:

1. All square, rectangular and round sections with a wall thickness of 5/8” or less: ASTM A500/A500M, Grade B structural tubing.

E. Steel Pipe: Wall thickness greater than 5/8”: ASTM A53/A53M, Type E or Type S, Grade B.
F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts.
B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts.
C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.3 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36.
B. Headed Anchor Rods: ASTM F1554, Grade 36, straight.
C. Threaded Rods: ASTM A36/A36M.

2.4 PRIMER

A. Steel Primer:

1. Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.5 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and non-staining, mixed with water to consistency suitable for application and a 30-minute working time. Capable of developing minimum compressive strength of 4000 psi at 28 days.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
B. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.8 SOURCE QUALITY CONTROL

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

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E165/E165M.
b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E164.
d. Radiographic Inspection: ASTM E94/E94M.

4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M.
5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
B. Baseplates Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

A. Reference structural drawings for additional Special Inspection requirements as designated per Chapter 17 of the Michigan Building Code.
B. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

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

1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1) Liquid Penetrant Inspection: ASTM E165/E165M.

2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3) Ultrasonic Inspection: ASTM E164.
4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION

SECTION 052100
STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Open web steel joists and joist girders with bridging, attached seats and anchors.
2. Framed Floor and roof openings greater than 18”.
3. Joist accessories.

1.2 RELATED SECTIONS

A. Section 033000 – Cast-in-place Concrete: Grouting bearing plates.
B. Section 051200 – Structural Steel Framing.
C. Section 053100 – Steel Decking: Support framing for small openings in floor and roof deck.
D. Section 055000 – Metal Fabrications: Non-framing steel fabrications.

1.3 REFERENCES

A. ASTM A325-High Strength Bolts for Structural Steel Joints.
B. AWS D1.1 – Structural Welding Code.
C. SJI – Standard Specifications for Open Web Steel Joists K Series.
D. SJI – Standard Specifications for Longspan Steel Joists LH Series and Deep Longspan Steel Joists DLH series.
E. SJI – Standard Specifications for Joist Girders.
F. SJI – Recommended Code of Standard Practice for Steel Joists and Joist Girders.
G. SSPC – Steel Structures Painting Council.

1.4 ACTION SUBMITTALS

A. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Submit shop drawings to architect for approval prior to fabrication.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.
B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

2.2 STEEL JOIST GIRDERS

A. Manufactured joist girders according to “Standard Specification for Joist Girders” n SJI’s “Specifications”, with steel angle top and bottom-chord members; with end and top-chord arrangements as follows:

1. End arrangement: Underslung with bottom-chord extension.
2. Top-Chord Arrangement: Parallel.
3. Camber: According to SJI’s “Specifications”.

2.3 PRIMERS

A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.4 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
C. Bridging: Fabricate as indicated and according to SJI's "Specifications" and "Standard Specification for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice." Furnish additional erection bridging if required for stability.
D. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.
E. Bolts, Nuts, and Washers: ASTM A325.
F. Welding Materials: AWS D1.1; type required for materials being welded.

2.5 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.
B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
D. Bolt joists to supporting steel framework using carbon-steel bolts.
E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.2 FIELD QUALITY CONTROL

A. Reference structural drawings for additional Special Inspection requirements as designated per Chapter 17 of the Michigan Building Code.
A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Visually inspect field welds according to AWS D1.1/D1.1M.
C. Visually inspect bolted connections.
D. Prepare test and inspection reports.

END OF SECTION

SECTION 053100
STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.
2. Composite floor deck.

1.2 ACTION SUBMITTALS

A. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.
B. Evaluation reports.
C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.2 ROOF DECK

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer. **Galvanized finish at exterior exposed areas, as indicated on drawings.**
2. Deck Profile: As indicated.
3. Profile Depth: 1-1/2 inches.
4. Design Uncoated-Steel Thickness: 22 gauge, **or as indicated on drawings**.
5. Anchorage: **As indicated on drawings.**

6. Acoustical Deck: **Inert, non-organic glass fiber sound absorbing batts placed in rib openings where acoustical deck is specified.**

2.3 COMPOSITE FLOOR DECK

A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Profile Depth: 1-1/2 inches.
3. Design Uncoated-Steel Thickness: 22 gauge, or as indicated on drawings.
4. Anchorage: #12 TEK screws at 12” o.c. max.

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
E. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
B. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
C. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
D. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
E. Fasten deck to steel support members at ends and intermediate supports with #12 TEK screws at 18" o.c. maximum.
F. Fasten male/female side laps with #10 TEK screws. Provide two screws evenly spaced between support members.
G. Reinforce steel deck openings from 6" to 18” in size with 2 x 2 x 3/16 steel angles. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fasten to deck at each flute.
H. Install 12" (minimum) wide 12 gauge sheet steel cover plates where deck changes direction. Fasten with #10 TEK screws at 12" o.c. maximum.
I. Immediately after fastening deck and other metal components in position, coat damaged surface coating with touch-up prime paint.
J. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

K. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Field welds will be subject to inspection.
C. Prepare test and inspection reports.

3.3 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

END OF SECTION

SECTION 054000
COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior non-load-bearing wall framing.
2. Interior non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.

1.2 RELATED SECTIONS

A. Section 052100 – Structural Steel Framing: Cold Formed Metal Framing supported by structural steel.
B. Section 061000 – Rough Carpentry.
C. Section

1.3 REFERENCES

A. AISI (American Iron and Steel Institute) - Cold-Formed Steel Design Manual.
B. AISI (American Iron and Steel Institute) - Residential Steel Framing Manual.
C. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
D. ASTM A570/A570M - Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
E. ASTM A611 - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Structural Quality.
F. ASTM A645/A645M - Standard Specification for Pressure Vessel Plates, Five Percent Nickel Alloy Steel, Specially Heat Treated.
G. ASTM A653, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.
H. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging, for Screw Application of Gypsum Board and Metal Plaster Bases.
I. AWS D1.1 (American Welding Society) - Structural Welding Code - Steel.
J. AWS D1.3 (American Welding Society) - Structural Welding Code - Sheet Steel.
K. ML/SFA 540 - (Metal Lath/Steel Framing Association, Division of National Association of Architectural Metal Manufacturers; NAAMM) - Lightweight Steel Framing Systems Manual.
L. SSPC-Paint 15 (Steel Structures Painting Council) - Steel Joist Shop Paint.
M. SSPC-Paint 20 (Steel Structures Painting Council) - Zinc Rich Primers.

1.4 SYSTEM DESCRIPTION

A. Size components to withstand design loads as indicated on Design Drawings.
B. Maximum Allowable Deflection: 1:360
C. Wall System:

1. Design to AISI – Cold-Formed Steel Design Manual.
2. Design to provide for 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.

3. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
4. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with 2021 Michigan Building code.

1.5 ACTION SUBMITTALS

A. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
3. Submit product information and calculations as designed per the Michigan building Code requirements under the direct supervision of a Professional Engineer licensed in the State of Michigan. Shop Drawings shall bear the seal of a licensed Michigan Engineer.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.
B. Product certificates.
C. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.7 QUALITY ASSURANCE

A. Calculate structural properties of framing members in accordance with AISI Specification for Design of Cold-Formed Steel Structural Members.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Installer: company specializing in performing work of this section with three years documented experience and approved by manufacturer.
C. Design structural elements under direct supervision of Professional Engineer experienced in design of this work and licensed in the State of Michigan.
D. Form, fabricate, provide, and connect components in accordance with ML/SFA 540 – Lightweight Steel Framing Systems Manual.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. ClarkDietrich
B. Cemco
C. Approved Equal.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

A. Studs: sheet steel, formed to channel shape, punched web.
B. Joists: sheet steel, formed to channel shape, punched web.

C. Track: Formed sheet steel; channel shaped; same width as studs, tight fit; solid web.
D. Headers and Posts: built up shapes to meet performance criteria of “System Description”.
E. Framing Materials: Roll from new sheet steel; cold reduction steels not being acceptable.

2.3 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined by performance requirements specified.
B. Plates, Gussets, Clips: Formed sheet steel, thickness determined by performance requirements specified.
C. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 zinc rich.

2.4 ANCHORS, CLIPS, AND FASTENERS

A. Self-drilling, Self-tapping Screws, Bolts, Nuts, and Washers: Steel, hot dip galvanized to ASTM A123 1.25 oz/sq ft.
B. Anchorage Devices: Power actuated, and/ or screws with sleeves.
C. Welding: In conformance with AWS D1.1 and AWS D1.3.

2.5 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20.
B. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C 1107/C 1107M, and with a fluid consistency and 30-minute working time.
C. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.6 FABRICATION

A. Fabricate assemblies of formed sections of sizes and profiles required.
B. Fit, reinforce, and brace framing members to suit design requirements.
C. Fit and assemble in larges practical sections for delivery to site, ready for installation.

2.7 FINISHES

A. Studs: Galvanize to G60 coating class
B. Tracks and Headers: Galvanize to G60 coating class.
C. Joists: Galvanize to G60 coating class.
D. Bracing Furring, and Bridging: Same finish as framing members.
E. Plates, Gussets, and Clips: Same finish as framing members.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify substrate surfaces and building framing components are ready to receive Work.
B. Verify rough-in utilities are in proper location.
C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.2 ERECTION OF STUDS

A. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners or by welding at maximum 16 inches oc. Place studs at 16 inches oc; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using method suitable for performance criteria.
B. Construct corners using minimum three studs. Double stud wall openings, door jambs, and window jambs.
C. Erect load bearing studs one piece full length. Splicing of studs is not permitted.
D. Erect load bearing studs, brace, and reinforce to develop full strength, to achieve design requirements.
E. Fully seat axial loaded studs in receiving tracks (maximum 1/16 inch gap between stud and track web).
F. Coordinate placement of insulation in multiple stud spaces after erection.
G. Install intermediate studs above and below openings to align with wall stud spacing.
H. Install studs with deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
I. Attach cross studs to studs for attachment of fixtures anchored to walls.
J. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
K. Touch-up field welds and damaged galvanized surfaces with primer.

3.3 ERECTION OF JOISTS

A. Install framing components.
B. Make provisions for erection stresses. Install temporary bracing to maintain alignment, until permanent bracing and attachments are installed.
C. Place joists at 16 inches oc; not more than 2 inches from abutting walls. Connect joists to supports using method suitable for performance criteria.
D. Set floor and roof joists parallel and level, with lateral bracing and bridging.
E. Locate joist end bearing directly over load bearing studs or install load distributing member to top of stud track.
F. Install web stiffeners at reaction points and other concentrated load points.
G. Touch-up field welds and damaged galvanized surfaces with primer.

3.4 ERECTION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

    1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.5 FIELD QUALITY CONTROL

A. Reference structural drawings for additional Special Inspection requirements as designated per Chapter 17 of the Michigan Building Code.
B. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
C. Field and shop welds will be subject to testing and inspecting.
D. Testing agency will report test results promptly and in writing to Contractor and Architect.
E. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

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

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

END OF SECTION

SECTION 055000
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.

B. Products furnished, but not installed, under this Section include the following:

1. Section 033000-Cast-in-Place Concrete: Placement of metal fabrications in concrete.
2. Section 042200-Concrete Unit Masonry: Placement of metal fabrications in masonry.
3. Loose steel lintels.
4. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

1.2 REFERENCES

A. ASTM A36-Structural Steel.
B. ASTM A53-Hot-Dipped, Zinc-Coated Welded and Seamless Steel Pipe.
C. ASTM 123-Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip.
D. ASTM A153-Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
E. ASTM 307-Carbon Steel Externally Threaded Standard Fasteners.
F. ASTM 325-High Strength Bolts for Structural Steel Joints.
G. ASTM A386-Zinc Coating (Hot-Dip) on Assembled Steel Products.
H. ASTM A500-Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
I. ASTM A992-Standard Specification for Structural Steel Shapes.
J. AWS A2.0-Standard Welding Code.
K. AWS D1.1-Structural Welding Code.
L. SSPC-Steel Structures Painting Council.

1.3 ACTION SUBMITTALS

A. Submit under provisions of Division 1.
B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
C. Indicate Welded connections using standard AWS A2.0 welding symbols. Indicate weld lengths.
D. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALIFICATIONS

A. Welder’s Certificates: Submit under provisions of Division 1, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.5 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on the Drawings.

PART 2 - PRODUCTS

2.1 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
B. Structural Steel Wide Flange (“W”) Shapes: ASTM A992
C. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
D. Stainless Steel Bars and Shapes: ASTM A276/A276M.
E. Hollow Structural Sections (“HSS”):

1. All square and rectangular sections, and round sections with a wall thickness of 5/8” or less: ASMT A500, Grade B.
2. Round Sections with wall thickness greater than 5/8”: ASTM A53, Grade B.

F. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
G. Rolled-Stainless Steel Floor Plate: ASTM A793.
H. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing Grade B.
I. Steel Pipe: ASTM A53/A53M, Standard Weight (Grade B, Schedule 40) unless otherwise indicated.
J. All other structural steel shapes, plates, and rods: ASTM A36.
K. Welding Materials: AWS D1.1; type required for materials being welded.
L. Bolts, Nuts, and Washers: ASTM A325 or A307 galvanized to ASTM 153 for galvanized components.

2.2 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

B. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.3 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a small uniform radius unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
D. Form exposed work with accurate angles and surfaces and straight edges.
E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.4 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.
B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
C. Prime paint items with one coat.

2.5 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
2. Galvanize in accordance with ASTM 123, structural steel members. Provide minmum 1.25 oz/sq. foot galvanized coating.

B. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC 15, Type 1.
D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.
B. Beginning of installation means erector accepts existing conditions.

3.2 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation;

with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.3 ERECTION TOLERANCES

A. Maximum variation from Plumb: 1/4” per story, non-cumulative.

B. Maximum Offset from true Alignment 1/4”.

3.4 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

3.5 SCHEDULE

A. The Schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.

B. Lintels: As detailed, prime paint finish. **Coordinate mechanical lintels with mechanical drawings. Lintels indicated on “Lintel Schedule” Sheet S2.0.**

C. **Mechanical Equipment Frames: As detailed per structural drawings, prime paint finish. Coordinate mechanical frames with mechanical drawings and as indicated on Framing Details Sheet S4.0, prime paint finish.**

D. **Electrical Transformer Supports: Per Keyonte on Sheet 2.0. Support required at two locations – one shown on Sheet S2.0 / second not shown but required above existing Electrical Room to power equipment at Home Ec renovations.**

END OF SECTION

SECTION 061000
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rooftop equipment bases and support curbs.
2. Wood blocking and nailers.
3. Wood furring.
4. Wood sleepers.
5. Plywood backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. OSB: Oriented strand board.

D. Timber: Lumber of 5 inches nominal size or greater in least dimension.

E. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

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PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.

B. Maximum Moisture Content of Lumber:

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. 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.

2.2 PRESERVATIVE TREATMENT

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

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2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Furring.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species: the following species:

1. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
2. Western woods; WCLIB or WWPA.
3. Northern species; NLGA.
4. Eastern softwoods; NeLMA.

C. Concealed Boards: 15 percent maximum moisture content and the following species and grades:

1. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch 3/4-inch nominal thickness.

2.5 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

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1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329 .
2. For pressure-preservative-treated wood, use stainless steel fasteners.
3. For redwood, use stainless steel or hot-dip galvanized-steel fasteners.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01,ICC-ES AC58,ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

2.6 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated . 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. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

2.7 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets:

1. Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

C. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

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PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

G. Do not splice structural members between supports unless otherwise indicated.

H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

I. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

J. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with

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function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

K. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

L. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

M. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. ICC-ES evaluation report for fastener.

N. Use steel common 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. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. 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.

3.3 INSTALLATION OF WOOD FURRING

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring horizontally and vertically at 24 inches 600 mm o.c.

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3.4 PROTECTION

A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

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SECTION 061600
SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.
2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

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1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.3 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. For interior use only.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

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D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat all plywood unless otherwise indicated.

2.4 WALL SHEATHING

A. Plywood Sheathing: Either DOC PS 1 or DOC PS 2 , Exterior sheathing.

1. Span Rating: Not less than 16/0 .

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M .
2. For wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

2.6 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

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PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

D. 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. Install fasteners without splitting wood.

E. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

END OF SECTION 061600

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SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 123623.13 "Plastic-Laminate-Clad Countertops."
3. Section 123661.16 “Solid-Surfacing Countertops.”

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.

C. Samples for the following:

1. Plastic Laminates: 12 by 12 inches, for each type, color, pattern, and surface finish required.
   a. Provide one sample applied to core material with specified edge material applied to one edge.
2. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers must have a minimum of 10 years’ experience in similar fabrications.

2.2 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents may contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Architectural Woodwork Standard: Duty Level 3 Minimum.

C. Type of Construction: Frameless.

D. Door and Drawer-Front Style: Flush overlay.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Wilsonart LLC
   b. Formica Corporation.
   c. Pionite; a Panolam Industries International, Inc. brand.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS .
2. Vertical Surfaces: Grade VGS .
3. Edges: Coordinated impact-resistant 3mm Edgeband matching laminate in color, pattern, and finish .
4. Pattern Direction: As indicated.

G. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS .
   a. Edges of Plastic-Laminate Shelves: Coordinated impact-resistant 3mm Edgeband matching laminate in color, pattern, and finish .
   b. Edges of Thermally Fused Laminate Panel Shelves: PVC or polyester edge banding.
   c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS .
2. Drawer Sides and Backs: Thermally fused laminate panels with PVC or polyester edge banding.
3. Drawer Bottoms: Hardwood plywood.

H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As selected by Architect from laminate manufacturer's full range.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Plywood.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Accuride International.
   b. Blum, Julius & Co., Inc.
   c. Hardware Resources.
   d. Knape & Vogt Manufacturing Company.

B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening. Grade 1 – Highest/Institutional Grade

C. Wire Pulls: Back mounted, solid metal , 4 inches long, 5/16 inch in diameter .

D. Shelf Rests: ANSI/BHMA A156.9, B04013; metal .

E. Drawer Slides: ANSI/BHMA A156.9.

1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount .
   a. Type: Full extension.
   b. Material: Epoxy-coated polymer slides.
   c. Motion Feature: Soft close dampener .
2. Pencil drawers not more than 3 inches high and not more than 24 inches wide, provide 50 lb load capacity.
3. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.
4. File drawers more than 6 inches high or more than 24 inches wide, provide 100 lb load capacity.
5. Lateral file drawers more than 6 inches high and more than 24 inches but not more than 30 inches wide, provide 150 lb load capacity.
6. Lateral file drawers more than 6 inches high and more than 30 inches wide, provide 200 lb load capacity.

F. Door Locks: ANSI/BHMA A156.11, E07121.

G. Drawer Locks: ANSI/BHMA A156.11, E07041.

H. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.

1. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.

I. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.6 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 064116

SECTION 072100
THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Glass-fiber blanket.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
2. Section 061600 "Sheathing"
3. Section 075419 "Polyvinyl-Chloride (PVC) Roofing" for insulation specified as part of roofing construction.
4. Section 098500 "Sound Transmission Control Materials" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded Polystyrene Board, Type X: ASTM C578, Type X, 15-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DiversiFoam Products.
b. Dow Chemical Company (The).
c. MBCI.
d. Owens Corning.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 FIBERGLASS BATT INSULATION

A. Batts: Fiberglass batt insulation faced, complying with ASTM C665 and meeting the following criteria:

1. ASTM C 665 type II Class A (batt with non-reflective facing, flame spread 25 or less), or III Class A (batt with reflective facing, flame spread 25 or less].
2. Full width batt for use with steel studs spaced 16”, and 24” on center.
3. Thermal Resistance: Measured in accordance with ASTM C 518, R-value 19.
4. Factory-applied facing:
   a. FSK (foil-scrim-kraft, Type III Class A, Category 1, facer is a vapor retarder with 0.02 water vapor permeance)
   b. Surface burning characteristics, ASTM E 84, flame spread 25 or less.
5. Water Vapor Permeance: Permeance of vapor retarding facings measured in accordance with ASTM E 96.

B. Manufacturers: Subject to compliance with product criteria, the manufacturers whose products may be incorporated into the work include but are not limited to:

1. CertainTeed Corporation.
2. Guardian Building Products.
3. Johns Manville.
4. Owens Corning

2.3 INSULATION FASTENERS

A. Joint Sealing Tape: Pressure sensitive, self-adhering, acrylic adhesive joint sealing tape, complying with AAMA 711, and, meeting the following criteria:

1. Recommended by its manufacturer for sealing the joints of extruded polystyrene insulation board in vertical cavity wall construction
2. Peel Adhesion Strength: Compliant with ICC-ES AC 148 and AAMA 711
3. Water Resistance and Joint Sealing: Compliant with ICC-ES AC 71
4. Air Permeance: Air permeance less than or equal to 0.02 L/s/m2, tested in accordance with ASTM E 2178
5. Service Temperature: Service temperature range shall be at least 0oF to 120oF maximum
6. Width: Minimum 3.5 inches.

B. Manufacturers: Subject to compliance with product criteria, the manufacturers whose products may be incorporated into the work include but are not limited to:

1. Owens Corning.

C. Acceptable Products: Subject to compliance with product criteria, the products that may be incorporated into the work include but are not limited to:

D. JointSealR™ Foam Joint Tape; 3.5” wide, 90’ long, supplied in rolls

E. ACCESSORIES

F. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer.

1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.
3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

B. Cellular-Glass Board Insulation: Install with closely fitting joints using adhesive pad attachment method according to manufacturer's written instructions.

3.5 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072119
FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam insulation.
2. Accessories.

B. Related Requirements:

1. Section 072100 "Thermal Insulation" for foam-plastic board insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Carlisle Spray Foam Insulation.
   b. Johns Manville; a Berkshire Hathaway company.
   c. Master Builders Solutions.

2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 75 or less.
   b. Smoke-Developed Index: 450 or less.
3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.

B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Spray insulation to envelop entire area to be insulated and fill voids.

C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

D. Cavity Walls: Install into cavities to thickness indicated on Drawings .

E. Apply barrier coatings in accordance with manufacturer's written instructions and to comply with requirements for listing and labeling for fire-propagation characteristics and surface-burning characteristics specified.

1. Use equipment and techniques best suited for substrate and type of material applied as recommended by coating manufacturer.
2. Apply coatings to prepared surfaces as soon as practical after preparation and before subsequent surface soiling or deterioration.
3. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Produce sharp lines and color breaks.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect spray foam insulation installation, including accessories. Report results in writing.

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION 072119

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SECTION 074213.13
METAL WALL PANELS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section covers the pre-finished, pre-fabricated Architectural metal wall panel system. All metal trim, accessories, fasteners, insulation and sealants indicated on the drawings as part of this section.
B. Drawings and general provisions of the Contract, including general and Supplementary Conditions and Division 01 Specifications, apply to this section.

1.2 SUMMARY

A. Section Includes
    1. Factory formed metal wall panels – complete assembly
B. Related work specified elsewhere
    1. Flashing and Trim: Division 7- Flashing and Sheet Metal
    2. Sealants: Division 7 Joint Sealers Sections

1.3 Definitions

A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, thermal, and accessories necessary for a complete weathertight system.

1.4 QUALITY ASSURANCE

A. Acceptable Manufacturers:
    A. Exceptional Metals
    B. Centria
    C. PAC-Clad
    D. Drexel
B. Manufacturer and erector shall demonstrate experience of a minimum of five (5) years in this type of project.
C. Sheet Metal Industry Standard: Comply with Sheet Metal and Air Conditioning Contractors National Association (SMACNA) *Architectural Sheet Metal Manual.*
D. Panels shall be factory-produced only. No portable, installer-owned or installer-rented machines will be permitted.

1.5 SUBSTITUTIONS

A. The material, products and equipment specified in this section establish a standard for required function, dimension, appearance and quality to be met by any proposed substitution.

SECTION 074213.13
METAL WALL PANELS

1.6 SYSTEM DESCRIPTION

A. Material to comply with:
   1. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

1.7 WALL PANEL SYSTEM PERFORMANCE TESTING

A. General Performance: Metal wall panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation or other defects in construction.
B. Panels to meet:
   1. Metal Wall or Metal Soffit System shall be designed to meet applicable Local Building Code and the Soffit System shall have been tested by the Manufacturer per ASTM E-330 and have the applicable Load Tables published from this Air Bag testing for negative loads.

1.8 WARRANTIES

A. Finish warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finish within specified warranty period.
   1. Exposed Panels Finish - deterioration includes the following:
      a. Color fading more than 5 hunter units when tested according to ASTM D 2244
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214
      c. Cracking, checking, peeling or failure of a paint to adhere to a bare metal.
   2. Warranty Period: 20 Years from the date of substantial completion
B. Applicator shall furnish written warranty for a two (2) year period from date of substantial completion of building covering repairs required to maintain roof and flashings in watertight condition

1.9 SUBMITTALS

A. Furnish detailed drawings showing profile and gauge of exterior sheets, location and type of fasteners, location, gauges, shape and method of attachment of all trim locations and types of sealants, and any other details as may be required for a weather-tight installation.
B. Provide finish/color samples for selection.
C. Shop drawings: Show fabrication and installation layouts of metal wall panels or metal soffit panels, details of edge conditions, panel profiles, corners, anchorages, trim, flashings, closures and accessories, and special details. Distinguish between factory and field-assembled work
D. Coordination Drawings: Plans, drawn to scale, on which the following are shown and coordinated with each other, based on input from installer of the items involved.

SECTION 074213.13
METAL WALL PANELS

1.10 DELIVERY, STORAGE AND HANDLING

A. Ordering: Comply with manufacturer's ordering instruction and lead time requirements to avoid construction delays.
B. Deliver components, sheets, metal wall panels and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.
C. Unload, store and erect metal wall panels in a manner to prevent bending, warping, twisting and surface damage.
D. Stack metal wall panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness. Do not store metal wall panels in contact with other materials that might cause staining, denting or other surface damage.
E. Protect strippable protective coating on any metal coated product from exposure to sunlight and high humidity, except to the extent necessary for material installation.

1.11 PROJECT CONDITIONS

A. Weather Limitations: proceed with installation only when existing and forecasted weather conditions permit metal wall panel work to be performed.
B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

PART 2 - PRODUCTS

2.0 PANEL DESIGN (MP1)

A. General: Provide factory-formed metal wall panels designed for wall, soffit and fascia applications where a flush or flat appearance is desired. A round interlock leg and concealed fastening system act to improve the flush appearance while providing additional strength.
B. Horizontal Panel Installation.
C. Panels shall be Flush Wall 12" widths with 1" height.
D. Panels to be produced Smooth - Factory Standard. Specifier note: Factory standard is smooth unless specified.
E. Forming: Use continuous end rolling method. No end laps on panels.

2.3 MATERIALS AND FINISHES

A. Preformed metal panels shall be fabricated of .040 Aluminum.
B. Color:
    1. MP1 – Bone White

C. Finish shall be Kynar 500 or Hylar 5000 Fluorocarbon coating with a top side film thickness of 0.70 to 0.90 mil over a 0.25 to 0.3 mil prime coat to provide a total dry film thickness of 0.95 to 1.25 mil, to meet AAMA 621. Bottom side shall be coated with a primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesions, flexibility and longevity as specified by Kynar 500 or Hylar 5000 finish supplier.
D. If Strippable coating to be applied on the pre-finished panels to the top side to protect the finish during fabrication, shipping and handling, film shall be removed before installation.
E. Field protection must be provided by the Contractor at the job site so material is not exposed to weather and moisture.
F. Forming: use continuous rolling method. No “portable rollforming” machines will be permitted on this project; no installer-owned or installer-rented machines shall be permitted. It is the intent of the Architect to provide Factory-Manufactured wall panel systems only for this project.
G. Trim: Trim shall be fabricated of the same material and finish to match the profile, and will be press broken in lengths of 10 to 12 feet. Trim shall be formed only by the manufacturer of their approved dealer. Trim to be erected in overlapped condition. Use lap strips only as indicated on drawings. Miter conditions shall be factory welded material to match the sheeting.
H. Accessories/Fasteners: Fasteners shall be of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous framing members to substrates. Accessories and their fasteners shall be capable of resisting the specified design wind uplift forces and shall allow for thermal movement of the wall panel system.
I. Insulation/Weatherproofing: See Section 072100: Thermal Insulation.
J. Sealants
    1. Provide two-part polysulfide class B non-sag type for vertical and horizontal joints or
    2. One part polysulfide not containing pitch or phenolic extenders or
    3. Exterior grade silicone sealant recommended by roofing manufacturer or
    4. One part non-sag, gun grade exterior type polyurethane recommended by the roofing manufacturer.

2.4 METAL WALL PANEL ACCESSORIES

A. Metal Wall Panel Accessories, General: Provide complete metal wall panel assembly incorporating trim, copings, fascias, parapet caps, soffits, sills, inside and outside corners, and miscellaneous flashings. Provide manufacturer's factory-formed clips, shims, flashings, gaskets, lap tapes, and closure strips for a complete installation. Fabricate and install accessories in accordance with SMACNA Manual.

B. Formed Flashing and Trim: Match material, thickness, and color of metal wall panel face sheets. Trim shall be fabricated of the same material and finish to match the profile, and will be press broken in lengths of 10 to 12 feet. Trim shall be formed only by the manufacturer of their approved dealer. Trim to be erected in overlapped condition. Use lap strips only as indicated on drawings

C. Fasteners: Self-tapping screws, bolts, nuts, and other acceptable fasteners recommended by panel manufacturer. Where exposed fasteners cannot be avoided for miscellaneous applications, supply corrosion-resistant fasteners with heads matching color of metal wall panels by means factory-applied coating.

D. Concealed Clips: Galvanized steel, 0.06 inch/16 ga. (1.52 mm) nominal thickness, designed to allow unimpeded thermal movement of panel and configured to hold panel minimum 1/2 inch (12.7 mm) from substrate.

2.5 FABRICATION

A. Comply with dimensions, profile limitations, gauges and fabrication details shown and if not shown, provide manufacturer's standard product fabrication.
    1. Max panel length is 55'.
B. Fabricate components of the system in factory, ready for field assembly.
C. Fabricate components and assemble units to comply with fire performance requirements specified.
D. Apply specified finishes in conformance with manufacturer's standard, and according to manufacturer's instructions.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine alignment of structural steel and related supports, primary and secondary roof framing, solid roof sheathing, prior to installation.
B. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of the Work.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FASTENERS

A. Secure units to supports.
B. Place fasteners as indicated in manufacturer's standards.

3.3 INSTALLATION

A. Compliance: Comply with manufacturer's product data, recommendations and installation instructions for substrate verification, preparation requirements and installation.
B. Panels shall be installed plumb and true in a proper alignment and in relation to the structural framing. The erector must have at least five years successful experience with similar applications.

C. Install metal panels, fasteners, trim and related sealants in accordance with approved shop drawings and as may be required for a weather-tight installation.
D. Provide uniform, neat seams.
E. Fasteners: Conceal fasteners where possible in exposed work. Cover and seal fasteners and anchors for watertight and leakproof installation.
F. Remove all strippable coating and provide a dry-wipe down cleaning of the panels as they are erected.

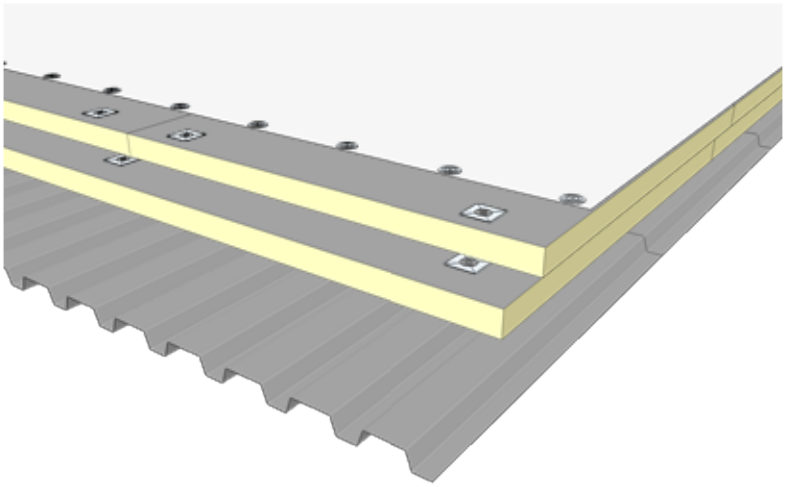
3.4 DAMAGED MATERIAL

A. Upon determination of responsibility, repair or replace damaged metal panels and trim to the satisfaction of the Architect and Owner.

3.5 CLEANING

A. Cleaning: Remove temporary coverings and protection of adjacent work areas.
B. Replace any damaged installed products. Clean installed products in accordance with manufacturer's instruction prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

END OF SECTION



Duro-Last Roof Assembly Description

- **Duro-Last® PVC thermoplastic membrane**
  Membrane Thickness: 50 mil
  Color: Grey
  Attachment: Attached with mechanical fasteners
- **Duro-Guard® ISO II (flat)**
  Attachment: Attached with mechanical fasteners
- **Steel Roof Deck**

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Duro-Last® PVC thermoplastic membrane attached with mechanical fasteners.

B. Duro-Guard® ISO II (flat), attached with mechanical fasteners.

C. Prefabricated flashings, corners, parapets, stacks, vents, and related details.

D. Fasteners, adhesives, and other accessories required for a complete roofing installation.

E. Traffic Protection.

1.2 REFERENCES

A. NRCA - The NRCA Roofing and Waterproofing Manual.

B. ASCE 7 - Minimum Design Loads For Buildings And Other Structures.

C. UL - Roofing Materials and Systems Directory, Roofing Systems (TGFU.R10128).

D. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

E. ASTM D 751 - Standard Test Methods for Coated Fabrics.

F. ASTM D 4434 - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing.

G. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings.

H. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

1.3 SYSTEM DESCRIPTION

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. Physical Properties:

1. Roof product must meet the requirements of Type III PVC sheet roofing as defined by ASTM D 4434 and must meet or exceed the following physical properties.
2. Thickness: 50 mil, nominal, in accordance with ASTM D 751.
3. Thickness Over Scrim: ≥ 28 mil in accordance with ASTM D 751.
4. Breaking Strengths: ≥ 390 lbf. (MD) and ≥ 438 lbf. (XMD) in accordance with ASTM D 751, Grab Method.
5. Elongation at Break: ≥ 31% (MD) and ≥ 31% (XMD) in accordance with ASTM D 751, Grab Method.
6. Heat Aging in accordance with ASTM D 3045: 176 °F for 56 days. No sign of cracking, chipping or crazing. (In accordance with ASTM D 4434).
7. Factory Seam Strength: ≥ 417 lbf. in accordance with ASTM D 751, Grab Method.

8. Tearing Strength: ≥ 132 lbf. (MD) and ≥ 163 lbf. (XMD) in accordance with ASTM D 751, Procedure B.
9. Low Temperature Bend (Flexibility): Pass at -40 °F in accordance with ASTM D 2136.
10. Accelerated Weathering: No cracking, checking, crazing, erosion or chalking after 5,000 hours in accordance with ASTM G 154.
11. Linear Dimensional Change: < 0.5% in accordance with ASTM D 1204 at 176 ± 2 °F for 6 hours.
12. Water Absorption: < 1.7% in accordance with ASTM D 570 at 158 °F for 166 hours.
13. Static Puncture Resistance: ≥ 56 lbs. in accordance with ASTM D 5602.
14. Dynamic Puncture Resistance: ≥ 14.7 ft-lbf. in accordance with ASTM D 5635.

D. Cool Roof Rating Council (CRRC):
   1. Membrane must be listed on CRRC website.
      a. Initial Solar Reflectance: ≥ 88%
      b. Initial Solar Reflective Index (SRI): ≥ 111
      c. 3-Year Aged Solar Reflectance: ≥ 68%
      d. 3-Year Aged Thermal Emittance: ≥ 84%
      e. 3-Year Aged Solar Reflective Index (SRI): ≥ 82

E. Insulation
   1. Provide overall thermal resistance for roofing system as follows:
   a. Minimum R-value: 30.
   2. Install using a minimum of two layers.
   3. Configuration as indicated on the Drawings.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Duro-Last data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.

C. Shop Drawings: Indicate insulation pattern, overall membrane layout, field seam locations, joint or termination detail conditions, and location of fasteners.

D. Verification Samples: For each product specified, two samples, representing actual product, color, and finish.
   1. 4 inch by 6 inch sample of roofing membrane, of color specified.

2. 4 inch by 6 inch sample of walkway pad.
3. Termination bar, fascia bar with cover, drip edge and gravel stop if to be used.
4. Each fastener type to be used for installing membrane, insulation/recover board, termination bar and edge details.

E. Installer Certification: Certification from the roofing system manufacturer that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

F. Manufacturer's warranties.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with manufacturer's installation instructions.

B. Manufacturer Qualifications: A manufacturer specializing in the production of PVC membranes systems and utilizing a Quality Control Manual during the production of the membrane roofing system that has been approved by and is inspected by Underwriters Laboratories.

C. Installer Qualifications: Company specializing in installation of roofing systems similar to those specified in this project and approved by the roofing system manufacturer.

D. Source Limitations: Obtain components for membrane roofing system from roofing membrane manufacturer.

E. There shall be no deviations from the roof membrane manufacturer's specifications or the approved shop drawings without the prior written approval of the manufacturer.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable code for roof assembly wind uplift and fire hazard requirements.

B. Fire Exposure: Provide membrane roofing materials with the following fire-test-response characteristics. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure:
    a. Class A; ASTM E 108, for application and roof slopes indicated.
2. Fire-Resistance Ratings: Comply with ASTM E 119 for fire-resistance-rated roof assemblies of which roofing system is a part.
3. Conform to applicable code for roof assembly fire hazard requirements.

C. Wind Uplift:

1. Roofing System Design: Provide a roofing system designed to resist uplift pressures calculated according to the current edition of the ASCE-7 Specification *Minimum Design Loads for Buildings And Other Structures*.

1.7 PRE-INSTALLATION MEETING

A. Convene meeting not less than one week before starting work of this section.

B. Review methods and procedures related to roof deck construction and roofing system including,

but not limited to, the following.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing installer, roofing system manufacturer's representative, deck installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
4. Review structural loading limitations of roof deck during and after roofing.
5. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
6. Review governing regulations and requirements for insurance and certificates if applicable.
7. Review temporary protection requirements for roofing system during and after installation.
8. Review roof observation and repair procedures after roofing installation.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Store roof materials and place equipment in a manner to avoid permanent deflection of deck.

E. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.9 WARRANTY

A. Contractor's Warranty: The contractor shall warrant the roof application with respect to workmanship and proper application for two (2) years from the effective date of the warranty issued by the manufacturer.

B. Manufacturer's Warranty: Must be no-dollar limit type and provide for completion of repairs, replacement of membrane or total replacement of the roofing system at the then-current material and labor prices throughout the life of the warranty. In addition the warranty must meet the following criteria:

1. Warranty Period: 20 years from date issued by the manufacturer.
2. Must provide positive drainage.
3. No exclusion for damage caused by biological growth.
4. Issued direct from and serviced by the roof membrane manufacturer.

5. Transferable for the full term of the warranty.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Manufacturer: Duro-Last Roofing, Inc., which is located at: 525 Morley Drive, Saginaw, MI 48601. Telephone: 800-248-0280.

B. All roofing system components to be provided or approved by roofing manufacturer.

C. Substitutions: Equal or Comparable Product substitutions will be considered, submit substitution requests following Div 1 instructions, 7 days prior to bid due date.

2.2 ROOFING SYSTEM COMPONENTS

A. Roofing Membrane: Duro-Last® PVC thermoplastic membrane conforming to ASTM D 4434, type III, fabric-reinforced, PVC, NSF/ANSI 347 Gold or Platinum Certification, and a product-specific third-party verified Environmental Product Declaration. Membrane properties as follows:

1. Thickness:
    a. 50 mil.
2. Exposed Face Color:
    a. Gray
3. Minimum recycle content 7% post-industrial and 0% post-consumer.
4. Recycled at end of life into resilient flooring or concrete expansion joints.

B. Accessory Materials: Provide accessory materials supplied by or approved for use by Duro-Last Roofing, Inc.

1. Sheet Flashing: Manufacturer's standard reinforced PVC sheet flashing.
2. Duro-Last Factory Prefabricated Flashings: manufactured using Manufacturer's standard reinforced PVC membrane.
    a. Stack Flashings.
    b. Curb Flashings.
    c. Inside and Outside Corners.
3. Sealants and Adhesives: Compatible with roofing system and supplied by Duro-Last Roofing, Inc.
    a. Duro-Caulk® Plus.
    b. Strip Mastic.
4. Slip Sheet: Compatible with roofing system and supplied by Duro-Last Roofing, Inc.
5. Fasteners and Plates: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane and insulation to substrate. Supplied by Duro-Last Roofing, Inc.
    a. #14 Heavy Duty Fasteners.
    b. Cleat Plates.

c. 3 inch Metal Plates.

6. PV Anchors
7. Termination and Edge Details: Supplied by Duro-Last Roofing, Inc.
   a. Termination Bar.
   b. Universal 2-Piece Compression Metal System.
      i. Color: MP2 – Terra Cotta
8. Vinyl Coated Metal: Supplied by Duro-Last Roofing, Inc. 24 gauge, hot-dipped galvanized, grade 90 metal with a minimum of 17 mil of Duro-Last membrane laminated to one side.
9. Two-Way Roof Vents: Supplied by Duro-Last Roofing, Inc. Install a minimum of 1 vent for each 1,000 ft² (93 m²) of roof area.

C. Walkways:
1. Provide non-skid, maintenance-free walkway pads in areas of heavy foot traffic and around mechanical equipment.
   a. Duro-Last Roof Trak® III Walkway Pad.

2.3 ROOF INSULATION

A. General:
1. Provide preformed roof insulation boards that comply with requirements and referenced standards, as selected from manufacturer's standard sizes.
2. Provide preformed saddles, crickets, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

B. Polyisocyanurate Board Insulation: Complying with ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces. Material as supplied by Duro-Last.
1. Duro-Guard® ISO II (flat).
2. Duro-Guard® ISO II (flat).

2.4 ROOF INSULATION ACCESSORIES

A. General: Provide roof insulation accessories approved by the roof membrane manufacturer and as recommended by insulation manufacturer for the intended use.

B. Fasteners: Provide Duro-Last factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening insulation and/or insulation cover boards in conformance to specified design requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that the surfaces and site conditions are ready to receive work.

B. Verify that the deck is supported and secured.

C. Verify that the deck is clean and smooth, free of depressions, waves, or projections, and properly sloped to drains, valleys, eaves, scuppers or gutters.

D. Verify that the deck surfaces are dry and free of standing water, ice or snow.

E. Verify that all roof openings or penetrations through the roof are solidly set.

F. If substrate preparation is the responsibility of another contractor, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Surfaces shall be clean, smooth, free of fins, sharp edges, loose and foreign material, oil, grease, and bitumen.

3.3 INSTALLATION

A. Install insulation in accordance with the roof manufacturer's requirements.

B. Insulation: Duro-Guard® ISO II (flat).

1. Install insulation in accordance with the roof manufacturer’s requirements.
2. Insulation shall be adequately supported to sustain normal foot traffic without damage.
3. Where field trimmed, insulation shall be fitted tightly around roof protrusions with no gaps greater than ¼ inch.
4. No more insulation shall be applied than can be covered with the roof membrane by the end of the day or the onset of inclement weather.
5. If more than one layer of insulation is used, all joints between subsequent layers shall be offset by at least 6 inches.
6. Mechanical Attachment: Use only fasteners, stress plates and fastening patterns accepted for use by the roof manufacturer. Fastening patterns must meet applicable design requirements.
    a. Install fasteners in accordance with the roof manufacturer’s requirements. Fasteners that are improperly installed must be replaced or corrected.
7. Mechanically attach Duro-Guard® ISO II (flat) insulation boards in parallel courses with end joints staggered 50% and adjacent boards butted together with no gaps greater than ¼ inch.

C. Roof Membrane: 50 mil, Duro-Last® PVC thermoplastic membrane.

1. Use only fasteners, stress plates and fastening patterns accepted for use by the roof manufacturer. Fastening patterns must meet the applicable design requirements.
2. Install fasteners in accordance with the roof manufacturer’s requirements. Fasteners that are improperly installed shall be replaced or corrected.
3. Mechanically fasten membrane to the structural deck utilizing fasteners and fastening patterns that in accordance with the roof manufacturer’s requirements.
4. Cut membrane to fit neatly around all penetrations and roof projections.
5. Unroll roofing membrane and positioned with a minimum 6 inch overlap.

D. Seaming:

1. Weld overlapping sheets together using hot air. Minimum weld width is 1-1/2 inches.

2. Check field welded seams for continuity and integrity and repair all imperfections by the end of each work day.

E. Membrane Termination/Securement: All membrane terminations shall be completed in accordance with the membrane manufacturer's requirements.

1. Provide securement at all membrane terminations at the perimeter of each roof level, roof section, curb flashing, skylight, expansion joint, interior wall, penthouse, and other similar condition.

2. Provide securement at any angle change where the slope or combined slopes exceeds two inches in one horizontal foot.

F. Flashings: Complete all flashings and terminations as indicated on the drawings and in accordance with the membrane manufacturer's requirements.

1. Provide securement at all membrane terminations at the perimeter of each roof level, roof section, curb flashing, skylight, expansion joint, interior wall, penthouse, and other similar condition.

a. Do not apply flashing over existing thru-wall flashings or weep holes.

b. Secure flashing on a vertical surface before the seam between the flashing and the main roof sheet is completed.

c. Extend flashing membrane a minimum of 6 inches (152 mm) onto the main roof sheet beyond the mechanical securement.

d. Use care to ensure that the flashing does not bridge locations where there is a change in direction (e.g. where the parapet meets the roof deck).

2. Penetrations:

a. Flash all pipes, supports, soil stacks, cold vents, and other penetrations passing through the roofing membrane as indicated on the Drawings and in accordance with the membrane manufacturer's requirements.

b. Utilize custom prefabricated flashings supplied by the membrane manufacturer.

c. Existing Flashings: Remove when necessary to allow new flashing to terminate directly to the penetration.

3. Pipe Clusters and Unusual Shapes:

a. Clusters of pipes or other penetrations which cannot be sealed with prefabricated membrane flashings shall be sealed by surrounding them with a prefabricated vinyl-coated metal pitch pan and sealant supplied by the membrane manufacturer.

b. Vinyl-coated metal pitch pans shall be installed, flashed and filled with sealant in accordance with the membrane manufacturer's requirements.

c. Pitch pans shall not be used where prefabricated or field fabricated flashings are possible.

G. Roof Drains:

1. Coordinate installation of roof drains and vents specified in Section 15146 - Plumbing Specialties.

2. Remove existing flashing and asphalt at existing drains in preparation for sealant and membrane.

3. Provide a smooth clean surface on the mating surface between the clamping ring and the drain base.

H. Edge Details:

1. Provide edge details as indicated on the Drawings. Install in accordance with the membrane manufacturer's requirements.
2. Join individual sections in accordance with the membrane manufacturer's requirements.
3. Coordinate installation of metal flashing and counter flashing specified in Section 07620.
4. Manufactured Roof Specialties: Coordinate installation of copings, counter flashing systems, gutters, downspouts, and roof expansion assemblies specified in Section 07710.

I. Walkways:

1. Install walkways in accordance with the membrane manufacturer's requirements.
2. Provide walkways where indicated on the Drawings.
3. Install walkway pads at roof hatches, access doors, rooftop ladders and all other traffic concentration points regardless of traffic frequency. Provided in areas receiving regular traffic to service rooftop units or where a passageway over the surface is required.
4. Do not install walkways over flashings or field seams until manufacturer's warranty inspection has been completed.

J. Water cut-offs:

1. Provide water cut-offs on a daily basis at the completion of work and at the onset of inclement weather.
2. Provide water cut-offs to ensure that water does not flow beneath the completed sections of the new roofing system.
3. Remove water cut-offs prior to the resumption of work.
4. The integrity of the water cut-off is the sole responsibility of the roofing contractor.
5. Any membrane contaminated by the cut-off material shall be cleaned or removed.

3.4 FIELD QUALITY CONTROL

A. The membrane manufacturer's representative shall provide a comprehensive final inspection after completion of the roof system. All application errors shall be addressed and final punch list completed.

3.5 PROTECTION

A. Protect installed roofing products from construction operations until completion of project.

B. Where traffic is anticipated over completed roofing membrane, protect from damage using durable materials that are compatible with membrane.

C. Repair or replace damaged products after work is completed.

END OF SECTION

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SECTION 078413
PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetration firestopping systems for the following applications:
   a. Penetrations in fire-resistance-rated walls.
   b. Penetrations in horizontal assemblies.
   c. Penetrations in smoke barriers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
        1) UL in its "Fire Resistance Directory."
        2) Intertek Group in its "Directory of Listed Building Products."
        3) FM Approval in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. 3M Fire Protection Products.
    b. Hilti, Inc.
    c. Tremco, Inc.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

D. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. 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:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.

4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.3 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

SECTION 079200
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Mildew-resistant joint sealants.
4. Latex joint sealants.

1.2 ACTION SUBMITTALS

A. Product data.

B. Manufacturers color selection sheets.

1.3 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Manufacturers' special warranties.
2. Installer's special warranties.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Authorized representative who is trained and approved by manufacturer.

1.5 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Pecora Corporation.
   b. Sika Corporation; Joint Sealants.
   c. The Dow Chemical Company.

B. Silicone, S, NS, 50, T, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Soudal USA.
   b. The Dow Chemical Company.

C. Silicone, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Pecora Corporation.
   b. Sika Corporation; Joint Sealants.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. GE Construction Sealants; Momentive Performance Materials Inc.
   b. Pecora Corporation.
   c. The Dow Chemical Company.
   d. Tremco Incorporated.

C. Silicone, Nonstaining, S, NS, 100/50, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. The Dow Chemical Company.

2.4 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. GE Construction Sealants; Momentive Performance Materials Inc.
   b. Pecora Corporation.
   c. The Dow Chemical Company.
   d. Tremco Incorporated.

2.5 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Pecora Corporation.
   b. Sherwin-Williams Company (The).
   c. Tremco Incorporated.

2.6 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and

approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
   d. Exterior insulation and finish systems.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
4. Provide flush joint profile in accordance with Figure 8B in ASTM C1193.
5. Provide recessed joint configuration of recess depth in accordance with Figure 8C in ASTM C1193.
    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

H. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.3 JOINT-SEALANT SCHEDULE

A. Exterior joints in vertical surfaces and horizontal nontraffic surfaces:

1. Joint Locations:
    a. Control and expansion joints in unit masonry.
    b. Joints in exterior insulation and finish systems.
    c. Joints between metal panels.
    d. Joints between different materials listed above.
    e. Perimeter joints between materials listed above and frames of doors windows.
    f. Other joints as indicated on Drawings.
2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT
3. Joint-Sealant Color: Clear

B. Interior joints in vertical surfaces and horizontal nontraffic surfaces:

1. Joint Locations:

a. Vertical joints on exposed surfaces of unit masonry walls and partitions.
b. Joints on underside of plant-precast structural concrete.
c. .

2. Joint Sealant: Urethane, S, NS, 25, NT
3. Joint-Sealant Color: Clear

C. Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement:

1. Joint Locations:
   a. Control joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
2. Joint Sealant: Acrylic latex
3. Joint-Sealant Color: Clear.

D. Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces:

1. Joint Locations:
   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.
2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT
3. Joint-Sealant Color: Clear

END OF SECTION 079200

SECTION 081113
HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Interior standard steel door and window frames.

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
2. Section 081416 "Flush Wood Doors" for wood doors in hollow metal frames.
3. Section 088000 “Glazing” for glass in hollow metal frames.

1.2 DEFINITIONS

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

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

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

B. Shop Drawings: Include the following:

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

6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
3. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

2.2 INTERIOR STANDARD STEEL DOOR FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Door Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule .

1. Frames:
   a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
   b. Construction: Full profile welded.
2. Exposed Finish: Prime .

2.3 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

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

2.4 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.5 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.6 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11 NAAMM-HMMA 840.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
   a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
   b. Install frames with removable stops located on secure side of opening.
2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.
   a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
4. Solidly pack mineral-fiber insulation inside frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416
FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Five-ply flush wood veneer-faced doors for transparent finish.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door trim for openings.
5. Door frame construction.
6. Factory-machining criteria.
7. Factory- finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Dimensions and locations of mortises and holes for hardware.
7. Clearances and undercuts.

8. Requirements for veneer matching.
9. Doors to be factory finished and application requirements.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Delamination of veneer.
   b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
   c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.3 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."

2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Doors :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. VT Industries Inc.
   b. Graham Wood Doors
   c. Lambton Doors.
   d. Masonite Architectural.
   e. Oshkosh Door Company

2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty .
3. Architectural Woodwork Standards ANSI/WDMA I.S. 1A Grade: Custom.
4. Faces:
   a. Species: Select white maple .
   b. Cut: Plain sliced (flat sliced) .
   c. Match between Veneer Leaves: Book match.
   d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
   e. Pair and Set Match: Provide for doors hung in same opening.
   f. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet or more.
   g. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
5. Exposed Vertical Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type B Minimum 1/16” thick. Edge before facing. Chamfered corners.

6. Core for Non-Fire-Rated Doors:
   a. ANSI A208.1, particleboard.
      1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
         a) 5-inch top-rail blocking, in doors indicated to have closers.
         b) 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
      2) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware."
   b. Glued wood stave.
   c. WDMA I.S. 10 structural composite lumber.
      1) Screw Withdrawal, Door Face: 550 lbf .
      2) Screw Withdrawal, Vertical Door Edge: 550 lbf .
   d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
7. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.5 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.

2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.7 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium.
2. Finish: Architectural Woodwork Standards System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
3. Staining: As selected by Architect from manufacturer's full range .
4. Effect: Filled finish .
5. Sheen: Satin .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Install frames level, plumb, true, and straight.

1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
2. Anchor frames to anchors or blocking built in or directly attached to substrates.

a. Secure with countersunk, concealed fasteners and blind nailing.
b. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork.
1) For factory-finished items, use filler matching finish of items being installed.

3. Install fire-rated doors and frames in accordance with NFPA 80.
4. Install smoke- and draft-control doors in accordance with NFPA 105.

D. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:
a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
c. Where threshold is shown or scheduled, provide1/4 inch from bottom of door to top of threshold unless otherwise indicated.
d. Comply with NFPA 80 for fire-rated doors.
5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
6. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

Soundmaster® Accordion
08 35 13 (083513)
Accordion Folding Doors

SPECIFICATION - SECTION 08 35 13 ACCORDION FOLDING DOORS

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes the following:
1. Furnish and install accordion folding partitions as indicated in drawings.
B. Related Sections include the following:
1. Division 03 Sections for concrete tolerances required.
2. Division 05 Sections for primary structural support, including pre-punching of support members by structural steel supplier per partition supplier's template.
3. Division 06 Sections for wood framing and supports, and all blocking at head and jambs as required.
4. Division 09 Sections for wall and ceiling framing at head and jambs.

1.3 QUALITY ASSURANCE
A. Installer Qualifications: An experienced installer who is certified in writing by the partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
B. Preparation of the opening shall conform to the dimensions specified, plumb, level, and in accordance to building practices.
C. Acoustical Performance: Test partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure and classified in accordance with ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.
D. The folding partition must be manufactured by a certified ISO-9001-2015 company or an equivalent quality control system.

1.4 REFERENCE STANDARDS
A. ASTM International
1. ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
3. ASTM E84 - Surface Burning Characteristics of Building Materials.
4. ASTM E413 - Classification for Rating Sound Insulation
B. International Standards Organization
1. ISO 14021 - Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II Environmental Labeling).
2. ISO 14025:2011-10, Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures.
3. ISO 14040:2009-11, Environmental Management - Life Cycle Assessment - Principles and Framework.

4. ISO 14044:2006-10, Environmental Management - Life Cycle Assessment - Requirements and Guidelines.
5. ISO 21930 – Sustainability in Buildings and Civil Engineering Works — Core Rules for Environmental Product Declarations of Construction Products and Services.

1.5 SUBMITTALS
A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of partition, component, and accessory specified.
B. Shop Drawings: Show location and extent of partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
D. Samples: Color samples demonstrating full range of finishes available by architect. Verification samples will be available in same thickness and material indicated for the work.
E. Furnish materials that generate the least amount of pollution.
1. Furnish products and materials that have third party verified environmental product declarations (EPD's). Consider products and materials that have optimized environmental performance (reduced life cycle impacts). Products without an EPD or other disclosure documentation are not acceptable.
F. Buy American: Folding door to be manufactured in the United States in compliance with applicable U.S. Federal Trade Commission (FTC) and U.S. Customs Service and Border Protections regulations and be labeled "Made in America".

1.6 DELIVERY, STORAGE, AND HANDLING
A. Clearly mark packages and partitions with numbering systems used on Shop Drawings. Do not use permanent markings on partitions.
B. Protect partitions during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

1.7 WARRANTY
A. Provide written warranty by manufacturer of partitions agreeing to repair or replace any components with manufacturing defects.
B. Warranty period: Two (2) years.

PART 2 – PRODUCTS (SOUNDMASTER)

2.1 MANUFACTURERS, PRODUCTS, AND OPERATION
A. Manufacturers: Subject to compliance with requirements, provide product by the following:
1. Modernfold, Inc.
B. Doors to be manufactured in the U.S.A.
C. Products: Subject to compliance with the requirements, provide the following product:
1. Soundmaster #8 Accordion Folding Partition.

2.2 OPERATION
A. Soundmaster #8: Manually operated, top supported, accordion folding.

2.3 CONSTRUCTION

A. Shall consist of steel hinge plates welded to 3/16-inch (5mm) diameter vertical steel rods, with a single row of plates at the bottom and top with intermediate rows at approximately 42-inch (1067mm) on center. Partitions 10'-0" (3048mm) high or over have a double row of hinge plates at the top. A high tensile alloy steel trolley yoke, functioning as a hinge pin at required intervals, supports the frame assembly.
B. Sound Transmission Class: Laboratory acoustical performance of the folding partition shall have been tested in an independent acoustical laboratory, in accordance with ASTM E90 test procedure, classified in accordance with ASTM E413 and shall have attained an STC rating of no less than:
1. Soundmaster 8 – 39 STC

2.4 PARTITION FINISHES
A. Finish: Face finish shall be (select as required):
1. Reinforced heavy-duty vinyl with woven backing weighing not less than 30 ounces per lineal yard.
2. Acoustical, non-woven needle punch carpet, with fused fibers to prevent unraveling or fray of material.
3. Wall covering and upholstery fabric with surface treatment to resist stains.
4. Customer's own material (subject to factory approval).
B. Partition Trim: Exposed sweep strips of one consistent color.

2.5 SOUND SEALS
A. Shall be pairs of three-layer flexible sweep strips at top and bottom. Vertical female sound channel shall be polyurethane foam lined.
B. Sound Insulation: 24-gage, V-grooved steel panels and heavy duty flame resistant acoustical membrane. Each panel attaches to the frame with steel leaf fasteners.
C. Pairs of Flexible Sweep Strips: Shall be provided at top and bottom of the partition. Air release for air trapped within the folding partition shall be accomplished during operation by a series of 3/8-inch (9.5mm) diameter holes through the lead post molding.

2.6 HARDWARE
A. Grip type hand pulls shall be die-cast zinc, satin chrome finish. Extruded aluminum or plastic hand pulls will not be accepted.

2.7 SUSPENSION SYSTEM
A. #5 (Soundmaster 8 only), #6, or #7 Suspension System, track and trolley sizes matched to the size of the partition.
1. Suspension Tracks: Shall be of a continuous "C" channel shaped track, connected to the structural support.
2. Carriers: The accordion folding partition shall be suspended from the track by two-wheel intermediate and four-wheel lead trolley assemblies.

2.8 OPTIONS
A. Jamb-Lock: Back post to be secured to the wall by the "Jamb-Lock" mechanism concealed within the back post to provide a quick means of releasing and reattaching the partition for cleaning and decorative purposes.
B. Locks: Satin chrome hand pulls with master-keyed locks. Master-keyed cylinders furnished by owner. Locks shall be an integral part of the pull; Manually Operated Partitions Only.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Comply with partition manufacturer's written installation instructions, Drawings, and approved Shop Drawings.
B. Install partitions and accessories after other finishing operations, including painting have been completed.
C. Defective partitions are not acceptable.

3.2 CLEANING AND PROTECTION
A. Clean partition surfaces upon completing installation of partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.
B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and installer that ensure operable partitions are without damage or deterioration at time of Substantial Completion.

3.3 ADJUSTING
A. Adjust partitions to operate smoothly, easily, and quietly throughout entire operational range. Lubricate hardware and other moving parts.

3.4 EXAMINATION
A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 DEMONSTRATION
A. Demonstrate proper operation and maintenance procedures to Owner's representative.
B. Provide Operation and Maintenance Manual to Owner's representative.

Modernfold, Inc.
215 West New Road
Greenfield, IN 46140
Toll Free: 800.869.9685
email: info@modernfold.com
www.modernfold.com

SECTION 084113
ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront systems.
2. Aluminum-framed entrance door systems.

B. Related Requirements:

1. Section 087100 "Door Hardware"
2. Section 088000 "Glazing"

1.2 ALLOWANCES

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
   a. Joinery, including concealed welds.
   b. Anchorage.
   c. Expansion provisions.
   d. Glazing.
   e. Flashing and drainage.
3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
4. Include point-to-point wiring diagrams showing the following:
   a. Power requirements for each electrically operated door hardware.
   b. Location and types of switches, signal device, conduit sizes, and number and size of wires.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Delegated Design Submittal: For aluminum-framed entrances and storefronts including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
    a. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

B. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For aluminum-framed entrances and storefronts.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Installers: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.
2. Delegated Design Engineer: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

1.7 WARRANTY

A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Structural failures, including, but not limited to, excessive deflection.
    b. Noise or vibration created by wind and thermal and structural movements.
    c. Deterioration of metals , metal finishes, and other materials beyond normal weathering.
    d. Water penetration through fixed glazing and framing areas.
    e. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
   c. Cracking, peeling, or chipping.
2. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:
   a. Thermal stresses transferring to building structure.
   b. Glass breakage.
   c. Noise or vibration created by wind and thermal and structural movements.
   d. Loosening or weakening of fasteners, attachments, and other components.
   e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings .

D. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. .

F. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:

1. Maximum Water Leakage: In accordance with AAMA 501.1 . Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

2.3 STOREFRONT SYSTEMS

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. EFCO Corporation.
2. Kawneer North America, an Arconic company.
3. Oldcastle BuildingEnvelope (OBE); CRH Americas.
4. Tubelite
5. Major Industries

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken .
2. Interior Vestibule Framing Construction: Nonthermal .
3. Glazing System: Retained mechanically with gaskets on four sides .
4. Glazing Plane: Front .
5. Finish: Clear Annodized .
6. Fabrication Method: Field-fabricated stick system.
7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
8. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 2-inch overall thickness, with minimum 0.188-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: Wide stile; 5-inch nominal width .
3. Glazing Stops and Gaskets: Square , snap-on, extruded-aluminum stops and preformed gaskets.
   a. Provide nonremovable glazing stops on outside of door.
4. Finish: Match adjacent storefront framing finish.

2.5 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.6 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials .

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

E. Rigid PVC filler.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from interior .
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, or thicker.

1. Color: Clear Annodized

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF OPERABLE UNITS

A. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

3.4 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.5 INSTALLATION OF WEATHERSEAL SEALANT

A. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass as recommended by sealant manufacturer.

B. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

3.6 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.7 ERECTION TOLERANCES

A. Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.

b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.8 MAINTENANCE SERVICE

A. Entrance Door Hardware Maintenance:

1. 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 entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

END OF SECTION 084113

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SECTION 084523

2-3/4" INSULATED TRANSLUCENT FIBERGLASS SANDWICH PANEL WALL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the insulated, translucent sandwich panel system and accessories as shown and specified. Work includes providing and installing:

1. **Flat** insulated, translucent sandwich panels
2. Aluminum Clamp-Tite TB installation system
3. Aluminum sill flashing

1.2 SUBMITTALS

A. Submit manufacturer's product data. Include construction details, material descriptions, profiles, and finishes of components.

B. Submit shop drawings. Include plans, elevations, and details.

C. Submit manufacturer's color charts showing the full range of colors available for factory finished exposed aluminum.

1. When requested, submit samples for each exposed finish required, in same thickness and material indicated for the work and in size indicated below.
   a. Sandwich panels: 7" x 12" units
   b. Factory finished aluminum: 3" long sections

D. Submit Installer Certificate, signed by installer, certifying compliance with project qualification requirements.

E. Submit product reports from a qualified independent testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed reports will be acceptable, if for current manufacturer and indicative of products used on this project.

1. Reports required (if applicable) are:
   a. Flame Spread and Smoke Developed (UL 723) – Submit UL Card
   b. Burn Extent (ASTM D 635)
   c. Color Difference (ASTM D 2244)
   d. Impact Strength (UL 972)
   e. Bond Tensile Strength (ASTM C 297 after aging by ASTM D 1037)
   f. Bond Shear Strength (ASTM D 1002)
   g. Beam Bending Strength (ASTM E 72)
   h. Insulation U-Factor (NFRC 100)
   i. NFRC System U-Factor Certification (NFRC 700)
   j. NFRC Visible Light Transmittance (NFRC 202)
   k. Solar Heat Gain Coefficient (NFRC or Calculations)
   l. Condensation Resistance Factor (AAMA 1503) (Thermally Broken, insulated panels only)
   m. Air Leakage (ASTM E 283)
   n. Structural Performance (ASTM E 330)

o. Water Penetration (ASTM E 331)
p. Fire Penetration of Exterior Wall Assemblies Using a Direct Flame Impingement Exposure (ASTM E2707)

1.3 CLOSEOUT SUBMITTALS

A. Provide field maintenance manual to include in project maintenance manuals.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Material and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten consecutive years and which can show evidence of those materials being satisfactorily used on at least six projects of similar size, scope, and location. At least three of the projects shall have been in successful use for ten years or longer.
2. Panel system must be listed by an ANSI accredited Evaluation Service, which requires quality control inspections and fire, structural, and water infiltration testing of sandwich panel systems by an accredited agency.
3. Quality control inspections shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components, and production sandwich panels for conformance with AC177 "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems" as issued by the ICC-ES.

B. Installer's Qualifications: Installation shall be by an experienced installer, which has been in the business of installing Kalwall panel systems for at least two consecutive years and can show evidence of satisfactory completion of projects of similar size, scope, and type.

1.5 PERFORMANCE REQUIREMENTS

A. The manufacturer shall be responsible for the configuration and fabrication of the complete panel system.

1. When requested, include span analysis data.
2. Standard panel system shall have less than 0.01 cfm/ft² air leakage by ASTM E 283 at 6.24 PSF (50 mph) and no water penetration by ASTM E 331 at 15 PSF; and structural testing by ASTM E 330.
3. Structural Loads. As indicated in structural drawings or as required by the 2021 Michigan Building Code and SEI/ASCE 7.

B. Deflection Limits:

1. Walls: Limited to [L/60] of clear span for each assembly component.

C. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 110 deg F (43 deg C), ambient; 150 deg F (66 deg C), material surfaces.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver panel system, components, and materials in manufacturer's standard protective packaging.

B. Store panels on the long edge; several inches above the ground, blocked and under cover in accordance with manufacturer's storage and handling instructions.

1.7 WARRANTY

A. Provide manufacturer's and installer's written warranties agreeing to repair or replace panel system work, which fails in material or workmanship, within (1) one year from the date of delivery. Failure of material or workmanship shall include deterioration of finish on metal in excess of normal weathering; and defects in accessories; insulated, translucent sandwich panels; and other components of the work.

B. Extended Panel Warranty: <**Insert Extended Warranty if required**> years from date of delivery.

C. Extended Manufacturer's factory applied Finish Warranty: <**Insert Extended Warranty if required**> years from date of delivery.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The basis for this specification is for products manufactured by Kalwall Corporation. Other manufacturers may bid this project subject to compliance with the performance requirements of this specification and submission of evidence thereof. Listing other manufacturers' names in this specification does not constitute approval of their products or relieve them of compliance with all the performance requirements contained herein.

B. Kalwall Corporation, Tel: (800) 258-9777 – Fax: (603) 627-7905 – Email: info@kalwall.com. Contact Michigan Representative – Joe Lucchese – J-M-L Arch. Prod., Inc. 313-642-1196 – O, email: jlucchese@comcast.net.

2.2 PANEL COMPONENTS

A. Face Sheets:

1. Translucent faces: Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.
   a. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.
   b. Face sheets shall not deform, deflect, or drip when subjected to fire or flame.
2. Interior face sheets:
   a. Flame spread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting, with flame spread rating no greater than and smoke developed no greater than 450 when tested in accordance with UL 723.
   b. Burn extent by ASTM D 635 shall be no greater than 1".
3. Exterior face sheets:
   a. Color stability: Full thickness of the exterior face sheet shall not change color more than 3 CIE Units DELTA E by ASTM D 2244 after **5** years outdoor South Florida weathering at 5° facing south as measured on a white sample, with and without a

protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.

b. Strength: Exterior face sheet shall be uniform in strength, impenetrable by hand held pencil and repel an impact minimum of **70 ft. lbs.** without fracture or tear when impacted by a 3-1/4" diameter, 5 lb. free-falling ball per UL 972.

c. Erosion Protection: Integral, embedded-glass erosion barrier.

4. Appearance:
   a. Exterior face sheet: Smooth**, .070 thick and White SW in color.**
   b. Interior face sheet: Smooth, **.045 thick and White S-171 in color.**
   c. Face sheets shall not vary more than ± 10% in thickness and be uniform in color.

B. Grid Core:

1. **Thermally Broken Composite** I-beam grid core shall be of alloy and temper recommended by manufacturer with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I-beam shall be no less than 7/16".
2. I-beam Thermal break: Minimum 1", thermoset fiberglass composite. Poured and de-bridged thermal break is not acceptable.

C. Laminate Adhesive:

1. Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council "Acceptance Criteria for Sandwich Panel Adhesives".
2. Minimum tensile strength of 750 PSI when the panel assembly is tested by ASTM C 297 after two exposures to six cycles each of the aging conditions prescribed by ASTM D 1037.
3. Minimum shear strength of the panel adhesive by ASTM D 1002 after exposure to four separate conditions:
   a. 50% Relative Humidity at 68° F: 540 PSI
   b. 182° F: 100 PSI
   c. Accelerated Aging by ASTM D 1037 at room temperature: 800 PSI
   d. Accelerated Aging by ASTM D 1037 at 182° F: 250 PSI

2.3 PANEL CONSTRUCTION

A. Provide sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking I-beams. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat, sharp edge.

1. Thickness: 2-3/4 inches
2. Grid Core Insulation: Fill panel cores with **fiberglass batt.**
3. Panel U-factor by NFRC certified laboratory:
   a. **2-3/4" thermally broken grid .23TB U-Factor**

4. Complete insulated panel system shall have NFRC certified U-factor
5. Visible Light Transmittance (VLT):
   a. Visible LT (NFRC 202) by NFRC certified laboratory: 16%. **White/White face sheet.**
6. Solar heat gain coefficient .22
7. Grid pattern as viewed: Nominal size 12" x 24" ; pattern Shoji

B. Standard panels shall deflect no more than 1.9" at 30 PSF in 10'-0" span without a supporting frame by ASTM E 72.

C. Panels shall meet the conditions of acceptance according to ASTM E2707 Fire Penetration of Exterior Wall Assemblies Using a Direct Flame Impingement Exposure:

1. Absence of flame penetration through the wall assembly at any time.
2. Absence of evidence of glowing combustion on the interior surface of the assembly at the end of the 60-min observation period.
3. Absence of evidence of flame, glow, and smoke if the test is terminated prior to the completion of the 60-min observation period.

D. Thermally broken, insulated panels: Minimum Condensation Resistance Factor of 80 by AAMA 1503 measured on the bond line.

2.4 ALUMINUM CLAMPTITE INSTALLATION SYSTEM

A. Aluminum Clamp-Tite TB installation system:
1. **2¾" Thermal System-Flat** Thermally Broken closure system: Thermal barrier shall consist of polyamide thermal strut construction with multi-directional glass fiber reinforcing. Aluminum components shall be mechanically crimped into cross knurled cavities. Poured and de-bridged thermal break is not acceptable**.**

B. Sealing tape: Manufacturer's standard, pre-applied to aluminum Clamp-Tite TB installation system at the factory under controlled conditions.

C. Fasteners: 300 series stainless steel screws for aluminum Clamp-Tite TB installation system, excluding final fasteners to the building.

D. Finish:
1. Manufacturer's factory applied paint finish, which meets the performance requirements of AAMA 2604. Color to be **selected from manufacturer's standards.**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installer shall examine substrates, supporting structure, and installation conditions.

B. Do not proceed with panel installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Metal Protection:
1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by sealant manufacturer for this purpose.
2. Where aluminum will contact concrete, masonry, or pressure treated wood, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by sealant manufacturer.

3.3 INSTALLATION

A. Install the panel system in accordance with the manufacturer's fabrication drawings and suggested installation instructions.
1. Anchor component parts securely in place by permanent mechanical attachment system.

2. Accommodate thermal and mechanical movements.
3. Seal aluminum Clamptite installation system as shown on the manufacturer’s fabrication drawings and suggested installation instructions.

B. Install joint sealants at perimeter joints and within the panel system in accordance with manufacturers fabrication drawings and suggested installation instructions.

3.4 FIELD QUALITY CONTROL

A. Water Test: Installer to test a representative section of installed materials according to procedures in AAMA 501.2.

B. Repair or replace work that does not pass testing or that is damaged by testing and retest work.

3.5 CLEANING

A. Clean the panel system, interior and exterior, immediately after installation.

B. Refer to manufacturer's written recommendations.

END OF SECTION 084523

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
   a. "Metal Doors and Frames"
   b. "Flush Wood Doors"
   c. "Stile and Rail Wood Doors"
   d. "Interior Aluminum Doors and Frames"
   e. "Aluminum-Framed Entrances and Storefronts"
   f. "Stainless Steel Doors and Frames"
   g. "Special Function Doors"
   h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
   a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
   b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   a. Wiring Diagrams: For power, signal, and control wiring and including:
      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
   a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule:
    a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
    b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
    c. Indicate complete designations of each item required for each opening, include:
        1) Door Index: door number, heading number, and Architect's hardware set number.
        2) Quantity, type, style, function, size, and finish of each hardware item.
        3) Name and manufacturer of each item.
        4) Fastenings and other pertinent information.
        5) Location of each hardware set cross-referenced to indications on Drawings.
        6) Explanation of all abbreviations, symbols, and codes contained in schedule.
        7) Mounting locations for hardware.
        8) Door and frame sizes and materials.
        9) Degree of door swing and handing.
        10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:
    a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
    b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
    c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
    d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
    e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
    f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
    a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
    b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
    a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
    b. Catalog pages for each product.
    c. Final approved hardware schedule edited to reflect conditions as installed.
    d. Final keying schedule

e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
   a. Fire door assemblies, in compliance with NFPA 80.
   b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
   d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
   a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
   b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:
   a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105

b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware
   a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:
   a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
   a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
      1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
      2) Preliminary key system schematic diagram.
      3) Requirements for key control system.
      4) Requirements for access control.
      5) Address for delivery of keys.

2. Pre-installation Conference
   a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Inspect and discuss preparatory work performed by other trades.
   c. Inspect and discuss electrical roughing-in for electrified door hardware.
   d. Review sequence of operation for each type of electrified door hardware.
   e. Review required testing, inspecting, and certifying procedures.
   f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:
   a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    a. Mechanical Warranty
        1) Locks
            a) Schlage L Series: 10 years
        2) Exit Devices
            a) Von Duprin: 10 years
        3) Closers
            a) LCN 4000 Series: 30 years
    b. Electrical Warranty
        1) Locks
            a) Schlage: 3 years
        2) Exit Devices
            a) Von Duprin: 3 years
        3) Closers
            a) LCN: 2 years

1.08 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

   1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.

B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

   1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
   2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
   3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with “Metal Doors and Frames”, “Flush Wood Doors”, “Stile and Rail Wood Doors” to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

   1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

   1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
   2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.

3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Ives 5BB series

2. Acceptable Manufacturers and Products:
   a. McKinney TB series
   b. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Ives 600 series

2. Acceptable Manufacturers:
   a. Best

b. Select

B. Requirements:

1. Provide pin and barrel continuous hinges conforming to ANSI/BHMA A156.26., Grade 1.
2. Provide pin and barrel continuous hinges fabricated from type 1012 cold rolled steel.
3. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
4. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide pin and barrel continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Best
   b. Roton

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.06 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage L9000 series

2. Acceptable Manufacturers and Products:
    a. No Substitute

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches. Provide motor based electrified and motor based latch retraction locksets that comply with the following requirements:
    a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
    b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case
    c. Low maximum current draw – maximum 0.4 amps (Lever control) and maximum 2.0 amps (Latch retraction) to allow for multiple locks on a single power supply.
    d. Low holding current (Lever control or latch retraction) – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications and motorized latch retraction applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
    e. Connections – provide quick-connect Molex system standard.

8. (OPTION Key Override) Provide locks with a key override feature built into the chassis that allows the outside key to retract the deadbolt and/or latchbolt, overriding the inside thumbturn when it is being held in the locked position - where the XL13-439 option is specified in the hardware sets.
9. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
    a. (OPTION Vandlgard) Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.
    b. Lever Design: <INSERT LEVER DESIGN>.

2.07 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
    a. Von Duprin 98/35A series

2. Acceptable Manufacturers and Products:
    a. No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices at pool gates with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Provide exit devices with manufacturers' approved strikes.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
17. Special Options:
    a. SI
        1) Provide dogging indicators for visible indication of dogging status.
    b. XP
        1) Rim Exit Devices: provide devices with non-tapered smart latchbolt with 90° latchbolt to strike engagement under stress and Static Load Resistance of 2000 pounds.
    c. QM
        1) Rim Exit Devices: provide devices with damper-controlled re-latching to reduce operational noise. Where lever trim is specified, provide damper controlled lever return.
    d. HH
        1) Provide wind and impact rated hurricane exit devices and mullions certified to comply with Florida Building Code (FBC) TAS 201, 202, 203.
    e. HW
        1) Provide wind rated hurricane exit devices and mullions certified to comply with ANSI-ASTM E330.
    f. CX
        1) Provide delayed egress devices, where scheduled, that are UL 294 listed, meet National Fire Protection Association (NFPA) and International Building Code (IBC) governing delayed egress, and/or other local and national fire codes acceptable to authority having jurisdiction as required.

a) Provide non-handed and field sizable device with 3/4 (19mm) throw deadlocking latch bolt. Device incorporates an internal RX switch that detects attempt to exit from applying less than 15lbs to the push pad, which causes this switch to start an irreversible alarm cycle. Key switch in device is capable of arming, disarming, or resetting the device; and indicator lamp determines status of the device.
b) Provide devices capable of standard 15 second release delay and indefinite release delay as required by code, when tied into fire alarm system will release immediately when an alarm condition exists.
c) Provide devices with all control inputs – door position input, external inhibit input, fire alarm input; auxiliary locking; nuisance alarm and internal horn; and, remote signaling output self-contained in the device assembly.

g. CVC
1) Provide cable-actuated concealed vertical latch system in two-point for non-rated or fire rated wood doors up to a 90 minute rating and less bottom latch (LBL) configuration for non-rated or fire rated wood doors up to 20 minute rating. Vertical rods are not permitted.
a) Cable: Stainless steel with abrasive resistant coating. Conduit and core wire ends snap into latch and center slides without use of tools.
b) Wood Door Prep: Maximum 1 inch x 1.1875 inch x 3.875 inches top latch pocket and 1 inch x 1.1875 inch x 5 inches bottom latch pocket which does not require the use of a metal wrap or edge for non-rated or fire rated wood doors up to a 45 minute rating.
c) Latchbolts and Blocking Cams: Manufactured from sintered metal low carbon copper- infiltrated steel, with molybdenum disulfide low friction coating.
d) Top Latchbolt: Minimum 0.38 inch (10 mm) and greater than 90-degree engagement with strike to prevent door and frame separation under high static load.
e) Bottom Latchbolt: Minimum of 0.44-inch (11 mm) engagement with strike.
f) Product Cycle Life: 1,000,000 cycles.
g) Latch Operation: Top and bottom latch operate independently of each other. Top latch fully engages top strike even when bottom latch is compromised. Separate trigger mechanisms not permitted.
h) Latch release does not require separate trigger mechanism.
i) Cable and latching system characteristics:
i. Installed independently of exit device installation, and capable of functioning on door prior to device and trim installation.
ii. Connected to exit device at single point in steel and aluminum doors, and two points for top and bottom latches in wood doors.
iii. Bottom latch height adjusted, from single point for steel and aluminum doors and two points for wood doors, after system is installed and connected to exit device, while door is hanging
iv. Bottom latch position altered up and down minimum of 2 inches (51 mm) in steel and aluminum doors without additional adjustment. Bottom latch deadlocks in every adjustment position in wood doors.
v. Top and bottom latches in steel and aluminum doors and top latch in wood doors may be removed while door is hanging.

2.08 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
a. Von Duprin 6000 Series

2. Acceptable Manufacturers and Products:
    a. No Substitute

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.09 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
    a. Schlage/Von Duprin PS900 Series

2. Acceptable Manufacturers and Products:
    a. Securitron BPS series
    b. Security Door Controls 600 series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
    a. 12/24 VDC Output, field selectable.
    b. Class 2 Rated power limited output.
    c. Universal 120-240 VAC input.
    d. Low voltage DC, regulated and filtered.
    e. Polarized connector for distribution boards.
    f. Fused primary input.
    g. AC input and DC output monitoring circuit w/LED indicators.
    h. Cover mounted AC Input indication.
    i. Tested and certified to meet UL294.
    j. NEMA 1 enclosure.
    k. Hinged cover w/lock down screws.
    l. High voltage protective cover.

2.10 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:
    a. Match Owner’s System

2. Acceptable Manufacturers and Products:

a. No Substitute

B. Requirements:

1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.11 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Telkee

2. Acceptable Manufacturers:
   a. No Substitute

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
   a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
   b. Provide hinged-panel type cabinet for wall mounting.

2.12 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4010/4110/4020 series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Certify surface mounted mechanical closers to meet fifteen million (15,000,000) full load cycles. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.

7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within 6-inch (152 mm) top rail without use of mounting plate so that closer is not visible through vision panel from pull side.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.13 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Rockwood

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.14 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.15 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:

a. Glynn-Johnson

2. Acceptable Manufacturers:
   a. Rixson
   b. Sargent

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.16 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.17 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Scheduled Manufacturer:

1. Zero International

B. Acceptable Manufacturers:

1. National Guard
2. Reese

C. Seals and Gasketing: Provide continuous gasketing on exterior openings, to the head and jambs, forming a continuous seal between the door and the frame. Provide smoke, light, or sound gasketing on interior doors where indicated.

1. Provide self-tapping fasteners for aluminum extruded gasketing being applied to hollow metal frames.
   a. Provide non-corrosive fasteners for all exterior applications.
   b. Provide security fasteners where indicated.

2. Provide neoprene, EPDM, silicone, or nylon brush inserts as specified in hardware sets. Provide non brush inserts of solid or sponge cell, as specified in hardware sets. Vinyl inserts are not allowed except where specified in hardware sets.

D. Smoke Labeled Gasketing: At all smoke labeled openings, provide smoke listed perimeter gasketing assemblies complying with NFPA 105 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.

E. Fire Listed Gasketing: Assemblies complying with NFPA 80 that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction for fire ratings indicated based on testing according to UL-10C.

1. Where frame-applied intumescent seals are required by the manufacturer, provide gaskets that comply with UL10C Standard for Positive Pressure Fire Tests of Door Assemblies and UBC 7-2, Fire Tests of Door Assemblies.

F. Sound-Rated Gasketing: Provide acoustic gasketing to meet Sound Transmission Class (STC) rating required.

G. Meeting-Stile Gasketing: Provide meeting-stile gasketing that fastens to the meeting stiles forming a continuous seal when doors are closed.

H. Door Sweeps or Shoes: Apply to the bottom of the door to close the gap between the door bottom and finished floor or saddle threshold.

1. Provide solid neoprene, EPDM, silicone, or nylon brush type of seal as specified in hardware sets. Vinyl inserts are not allowed except where specified in hardware sets.

I. Automatic Door Bottoms:

1. Provide closed cell sponge, bulb neoprene. or EPDM type of seal as specified in hardware sets.
2. Door bottom to be mortised, semi mortised, or surface mount as with a minimum thickness as specified in hardware sets.

J. Rain Drips:

1. Provide overhead rain drips for out-swinging hollow metal doors that are not covered against 45 degree blowing rain. Aluminum extrusion to be a minimum of .088 inches thick and extend 2.50 inches from the face of the frame, in anodized finish to match door.
2. Door sweeps or shoes with integral rain drip must meet ADA requirements

K. Thresholds: Provide threshold units not less than 4 inches wide, formed to accommodate change in floor elevation where indicated, and fabricated to accommodate door hardware and fit door frames.

1. Threshold extrusion to be a minimum thickness as specified in hardware sets.

2.18 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match

7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.
3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.

M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

P. Thresholds:

1. Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
2. Aluminum thresholds to be cut-in, and scribed around mullions, frame members, and stops. Do not butt to thresholds. Provide a continuous surface across full width of opening from jamb to jamb.
3. Where aluminum panic-type (rabbeted) thresholds with neoprene inserts are specified, undercut doors as required to properly mate with seal in threshold.

Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

R. Perimeter Gasketing:

1. Apply to head and jamb, forming seal between door and frame.
2. Install gasketing in a manner eliminating need to cut any seal to install surface mounted hardware. Install compatible mounting bracket for surface mounted hardware unless minimum 1/4 inch thick solid aluminum seals are provided for mounting of surface applied hardware.

S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 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.

1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to 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.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

156664 OPT0496881 Version 1

Legend:
Link to catalog cut sheet
Electrified Opening

Hardware Group No. 01

For use on Door #(s):
105.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	L9080BDC 03N		626	SCH
1	EA	SFIC MORTISE CYL.	80-132 (CAM/RING AS REQ'D)		626	SCH
1	EA	PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		626	
1	EA	SURFACE CLOSER	4111 EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS33/WS33X		626	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. 02

For use on Door #(s):
105.1 106 107 108

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	PRIVACY W/DEADBOLT	L9440 03N 09-544		626	SCH
1	EA	SURFACE CLOSER	4011		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS33/WS33X		626	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. 03

For use on Door #(s):
104

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 03N 09-544		626	SCH
1	EA	SFIC MORTISE CYL.	80-132 (CAM/RING AS REQ'D)		626	SCH
1	EA	PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		626	
1	EA	SURFACE CLOSER	4011		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS33/WS33X		626	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. 04

For use on Door #(s):
103

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 03N 09-544		626	SCH
1	EA	SFIC MORTISE CYL.	80-132 (CAM/RING AS REQ'D)		626	SCH
1	EA	PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		626	
1	EA	OH STOP	100S		689	GLY
1	EA	SURFACE CLOSER	4111 EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. 05

For use on Door #(s):
102.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		628	IVE
1	EA	STOREROOM LOCK	L9080BDC 03N		626	SCH
1	EA	SFIC MORTISE CYL.	80-132 (CAM/RING AS REQ'D)		626	SCH
1	EA	PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		626	
1	EA	SURFACE CLOSER	4011		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS33/WS33X		626	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	CARD READER/ACCESS CONTROL	BY SECURITY CONTRACTOR			B/O
1	EA	REMOTE RELEASE PUSH BUTTON	660-PB		628	SCE
1	EA	POWER SUPPLY	PS902 BBK 900-2RS		LGR	SCE

Hardware Group No. 06

For use on Door #(s):
102.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		628	IVE
1	EA	70 X 80 CLASSROOM X STOREROOM LOCK	L9060 03N XL-876		626	SCH
1	EA	PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		626	
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC		630	VON
1	EA	OH STOP	100S		689	GLY
1	EA	SURFACE CLOSER	4011 ST-1544		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	CARD READER/ACCESS CONTROL	BY SECURITY CONTRACTOR			B/O
1	EA	PUSH BUTTON	621GR 12/24 VDC		626	SCE
1	EA	REMOTE RELEASE PUSH BUTTON	660-PB		628	SCE
1	EA	POWER SUPPLY	PS902 BBK 900-2RS		LGR	SCE

Hardware Group No. 07

For use on Door #(s):
101.1

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY		628	IVE
1	EA	CONT. HINGE	112XY TWP CON	✓	628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	PANIC HARDWARE	LD-98-EO		626	VON
1	EA	ELEC PANIC HARDWARE	QEL-98-NL-OP-110MD 24 VDC	✓	626	VON
1	EA	SFIC RIM CYLINDER	80-116		613	SCH
1	EA	SFIC MORTISE CYL.	80-132 (CAM/RING AS REQ'D)		626	SCH
2	EA	PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)		626	
2	EA	90 DEG OFFSET PULL	8190EZHD 10" O		US26D	IVE
2	EA	OH STOP	100S		689	GLY
1	EA	SURFACE CLOSER	4111 EDA		689	LCN
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A		A	ZER
1	EA	CARD READER/ACCESS CONTROL	BY SECURITY CONTRACTOR	✓		B/O
1	EA	POWER SUPPLY	PS902 BBK 900-2RS	✓	LGR	SCE

DOORS REMAIN UNLOCKED DURING OPERATIONAL HOURS, DURING OFF HOURS DOORS REMAINED LOCKED AND NEEDS A VALID CREDENTIAL OR KEY FOR ENTRY. FREE EGRESS AT ALL TIMES

Hardware Group No. 08

For use on Door #(s):
101.2

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
2	EA	CONT. HINGE	112XY			628	IVE
1	EA	CONT. HINGE	112XY TWP CON			628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB			689	VON
1	EA	PANIC HARDWARE	LD-98-EO			626	VON
1	EA	ELEC PANIC HARDWARE	QEL-98-NL-OP-110MD 24 VDC			626	VON
1	EA	SFIC RIM CYLINDER	80-116			613	SCH
1	EA	SFIC MORTISE CYL.	80-132 (CAM/RING AS REQ'D)			626	SCH
2	EA	PERMANENT CORE	(MATCH OWNER'S EXISTING SYSTEM)			626	
2	EA	90 DEG OFFSET PULL	8190EZHD 10" O			US26D	IVE
2	EA	OH STOP	100S			689	GLY
1	EA	SURFACE CLOSER	4111 EDA			689	LCN
1	EA	MULLION SEAL	8780NBK PSA			BK	ZER
1	EA	CARD READER/ACCESS CONTROL	BY SECURITY CONTRACTOR				B/O
1	EA	POWER SUPPLY	PS902 BBK 900-2RS			LGR	SCE

END OF SECTION

SECTION 088000
GLAZING

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Section 081113 – HOLLOW METAL FRAMES

B. Section 081416 – FLUSH WOOD DOORS

C. Section 084113 – ALUMINUM FRAMED STOREFRONTS

1.2 REFERENCES

A. ANSI Z 97.1 - Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test.

B. ASTM C 1036 - Standard Specification for Flat Glass.

C. ASTM C 1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass.

D. ASTM C 1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Glass.

E. ASTM E 773 - Standard Test Method for Accelerated Weathering of Sealed Insulating Glass Units.

F. ASTM E 774 - Standard Specification for the Classification of the Durability of Sealed Insulating Glass Units

G. ASTM E 2188 – Standard Test Method for Insulating Glass Unit Performance.

H. ASTM E 2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.

I. CPSC 16CFR-1201 - Safety Standard for Architectural Glazing Materials.

J. Glass Association of North America (GANA) Glazing Manual.

1.3 DEFINITIONS

A. Sealed Insulating Glass Unit Surfaces:
   1. Surface No. 1: Exterior surface of outer lite.
   2. Surface No. 2: Interior surface of outer lite.
   3. Surface No. 3: Exterior surface of inner lite.
   4. Surface No. 4: Interior surface of inner lite.

B. Airspace: Space between lites of an insulating glass unit that contains dehydrated air or other inert specified gas.

1.4 SUBMITTALS

A. Comply with Section 013300 - Submittal Procedures.

B. Product Data: Submit manufacturer's product data, including performance characteristics and installation instructions.

C. Shop Drawings: Submit manufacturer's or fabricator's shop drawings, including plans, elevations, sections, and details, indicating glass dimensions, tolerances, types, thicknesses, and coatings.

D. Samples: Submit manufacturer's samples of each type, thickness, and coating.

E. Fabricator's Certification: Submit fabricator's certification by manufacturer.

F. Cleaning Instructions: Submit manufacturer's cleaning instructions.

G. Warranty: Submit manufacturer's standard warranty for sealed insulating glass units.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Minimum of 5 years experience manufacturing solar control coated glass.

B. Fabricator's Qualifications:
1. Minimum of 5 years experience manufacturing sealed insulating glass units meeting ASTM E 2190, Class CBA.
2. Certified by manufacturer.

C. Mock-Ups:
1. Comply with Section 014500 - Quality Control.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
1. Deliver glass to site in accordance with manufacturer's instructions.
2. Deliver glass in manufacturer's or fabricator's original containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage:
1. Store glass in accordance with manufacturer's instructions.
2. Store glass in clean, dry area indoors.
3. Protect from exposure to direct sunlight and freezing temperatures.
4. Apply temporary coverings loosely to allow adequate ventilation.
5. Protect from contact with corrosive chemicals.
6. Avoid placement of glass edge on concrete, metal, and other hard objects.

7. Rest glass on clean, cushioned pads at 1/4-points.

C. Handling:
1. Handle glass in accordance with manufacturer's instructions.
2. Protect glass from damage during handling and installation.
3. Do not slide 1 lite of glass against another.
4. Do not use sharp objects near unprotected glass.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The basis for this specification is for products manufactured by Guardian Glass / Safti. Other manufacturers may bid this project provided they comply with all of the performance requirements of this specification and submit evidence thereof. Listing other manufacturers' names in this specification does not constitute approval of their products or relieve them of compliance with all the performance requirements contained herein

B. Basis of Design: Guardian Glass / **Safti for Fire Glazing**

2.2 FABRICATORS

A. Sealed Insulating Glass Units, Heat-Strengthened Glass, Tempered Glass, and Spandrel Glass:
1. Acceptable Fabricators: Certified by Guardian Industries Corp. to fabricate SunGuard Solar Control Coated Glass products.

2.3 GLAZING

FIRE RATED GLAZING
1. Approved Product: Safti SuperLite I – 20 Minute Fire Protective Glazing
2. Finish: Clear
3. Impact Safety Glazing
4. Approved Products:
   a. SuperLite I – 20 Minute Fire Protective Glazing

GL- 1 A. Double-Glazed Sputter-Coated Insulating Glass Units:
1. Conformance: ASTM E 2190, Class CBA.
2. Outboard Lite: Sputter-coated clear float glass.
   a. Annealed Clear Float Glass: ASTM C 1036, Type 1, Class 1, Quality q3.
   b. Vacuum Deposition Sputtered Coating: ASTM C 1376.
   c. Coating on Surface No. 2: SunGuard SuperNeutral 68 (SN 68).
   d. Glass Thickness: 6 mm (1/4 inch).
   e. Heat Treatment: None
3. Air Space: 12 mm (1/2 inch) wide, hermetically sealed, dehydrated air space.
4. Inboard Lite: Clear float glass.

a. Annealed Clear Float Glass: ASTM C 1036, Type 1, Class 1, Quality q3.
b. Glass Thickness: 6 mm (1/4 inch).
c. Heat-Treatment: As required.

5. Edge Seals: ASTM E 773, with aluminum spacers and silicone sealant for glass-to-spacer seals.
6. Sealant: Approved by glass manufacturer.
7. Insulated Glazing System must meet AHSRAE 2019 – Prescriptive Requirements for Climate Zone 5. Coordinate Glazing with Storefront to achieve Maximum U and SHGC Requirements as stated.

GL-2 NON-INSULATED GLAZING

Uncoated Clear Fully Tempered Float Glass: Where glass as designated is indicated, provide Type I (transparent glass, flat), Class 1 (clear) glass lites.

EXECUTION

3.1 EXAMINATION

A. Examine areas to receive glass. Notify Architect of conditions that would adversely affect installation. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Verify glazing openings are correct size and within tolerance.

B. Verify glazing channels, recesses, and weeps are clean and free of obstructions.

3.3 GLAZING

A. Install glass in accordance with manufacturer's instructions, except where local codes or GANA Glazing Manual indicate more stringent requirements.

3.4 FIELD QUALITY CONTROL

A. Coated glass, when viewed from minimum of 10 feet, exhibiting slightly different hue or color not apparent in hand samples, will not be cause of rejection of glass units, as determined by Architect.

B. Verify glass is free of chips, cracks, and other inclusions that could inhibit structural or aesthetic integrity.

3.5 CLEANING

A. Clean glass promptly after installation in accordance with manufacturer's instructions.

B. Remove labels from glass surface.

C. Do not use harsh cleaning materials or methods that would damage glass.

3.6 PROTECTION

A. Protect installed glass from damage during construction.

B. Protect installed glass from contact with contaminating substances resulting from construction operations.

C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in other ways during construction period, including natural causes, accidents, and vandalism.

END OF SECTION 088000

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SECTION 092216
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for steel unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G40 ASTM A 653/A 653M, G60 Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 , hot-dip galvanized unless otherwise indicated.

B. Studs and Tracks: ASTM C 645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.

1. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection .
2. Depth: As indicated on Drawings .

C. Slip-Type Head Joints: Where indicated, provide the following:

1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Steel Thickness: As indicated on Drawings .
2. Depth: As indicated on Drawings 1-1/2 inches .

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

C. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.

1. Depth: 2 inches .

D. Furring Channels (Furring Members):

1. Steel Studs and Tracks: ASTM C 645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.
   a. Minimum Base-Steel Thickness: As indicated on Drawings .
   b. Depth: As indicated on Drawings .
2. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
   a. Minimum Base-Steel Thickness: As indicated on Drawings .
3. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
   a. Configuration: hat shaped.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
    a. Install two studs at each jamb unless otherwise indicated.

b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

E. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.3 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards .
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900
GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Gypsum wallboard.
2. Gypsum board, Type X.
3. Gypsum ceiling board.
4. Impact-resistant gypsum board.
5. Mold-resistant gypsum board.
6. Joint treatment materials.
7. Acoustical sealant.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Certainteed; SAINT-GOBAIN.
   b. Georgia-Pacific Gypsum LLC.

c. National Gypsum Company.
d. USG Corporation.

2. Thickness: 5/8 inch.
3. Long Edges: Tapered .

B. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Certainteed; SAINT-GOBAIN.
   b. Georgia-Pacific Gypsum LLC.
   c. National Gypsum Company.
   d. USG Corporation.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered .

C. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Certainteed; SAINT-GOBAIN.
   b. Georgia-Pacific Gypsum LLC.
   c. National Gypsum Company.
   d. USG Corporation.
2. Thickness: 1/2 inch.
3. Long Edges: Tapered.

D. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Certainteed; SAINT-GOBAIN.
   b. Georgia-Pacific Gypsum LLC.
   c. National Gypsum Company.
   d. USG Corporation.
2. Core: 5/8 inch , Type X.
3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
4. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
6. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements according to test in Annex A1.
7. Long Edges: Tapered.
8. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

E. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Certainteed; SAINT-GOBAIN.
   b. Georgia-Pacific Gypsum LLC.
   c. National Gypsum Company.
   d. USG Corporation.
2. Core: 5/8 inch , Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints , rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping drying-type, all-purpose compound.
3. Fill Coat: For second coat, use setting-type, sandable topping drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound drying-type, all-purpose compound .

2.5 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION AND FINISHING OF PANELS

A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

B. Comply with ASTM C840.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

E. Prefill open joints , rounded or beveled edges, and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 5: .
    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.2 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Interior porcelain floor tile, porcelain coved wall base, mortar-bed or thin-set setting materials, grout, movement joints, edge protection, and accessories required for a complete installation.

B. Related Requirements: Coordinate with Division 01 requirements, Section 07 92 00 for joint sealants, Section 09 06 00 or Finish Schedule for tile colors and patterns, and floor preparation sections for substrate tolerances and moisture mitigation.

1.2 REFERENCES

A. ANSI A108/A118/A136.1: Specifications for Installation of Ceramic Tile and related setting materials.

B. ANSI A137.1: American National Standard Specifications for Ceramic Tile, including porcelain tile and trim units.

C. ANSI A326.3: Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials.

D. TCNA Handbook for Ceramic, Glass, and Stone Tile Installation: Installation methods and movement-joint requirements applicable to project conditions.

1.3 ACTION SUBMITTALS

A. Product Data: Submit manufacturer’s data for tile, coved base, setting materials, grout, sealants, membranes, edge trims, and accessories.

B. Samples: Submit full-size samples of each porcelain floor tile, coved base trim, grout color, and exposed accessory finish.

C. Shop Drawings: Submit tile layout drawings indicating patterns, joint widths, coved base locations, transitions, movement joints, floor drains, slopes, and terminations.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an installer experienced in porcelain tile installations of similar size and complexity and employing installers trained in current ANSI and TCNA installation requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in unopened manufacturer containers with labels intact. Store tile and cementitious materials dry, elevated, and protected from contamination, freezing, and damage. Maintain lot consistency for visible tile and trim.

1.6 FIELD CONDITIONS

A. Maintain environmental conditions recommended by tile, setting-material, grout, membrane, and sealant manufacturers before, during, and after installation. Do not install tile over substrates that do not meet moisture, flatness, curing, cleanliness, or temperature requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Refer to Drawings for Product information

B. Single-Source Materials: Provide setting materials, grout, membranes, and related accessories from one manufacturer where practical to maintain compatibility.

2.2 PORCELAIN FLOOR TILE

A. Tile Type: as indicated on Drawings

B. Size and Thickness: as indicated on Drawings.

C. Finish: Slip-resistant matte or textured finish suitable for intended use; As indicated on Drawings

D. Joint Width: 1/8 inch typical. Coordinate joint layout to align with coved wall base joints and avoid sliver cuts.

2.3 COVED WALL BASE

A. Material: Porcelain coved base trim units matching or coordinating with porcelain floor tile and complying with ANSI A137.1.

B. Profile and Height: Integral cove base with sanitary radius toe; 6 inches high unless otherwise indicated. Provide factory inside corners, outside corners, end stops, and transition pieces where available.

C. Alignment: Coordinate base module, grout joint width, and joint alignment with floor tile layout. Where factory trim is unavailable, provide field-cut units only where approved and with finished, eased exposed edges.

2.4 SETTING MATERIALS

A. Thin-Set Mortar: Polymer-modified dry-set mortar complying with ANSI A118.4 or improved modified dry-set mortar complying with ANSI A118.15, as recommended by mortar and tile manufacturers for substrate and tile size.

C. Waterproofing or Crack-Isolation Membrane: Provide ANSI A118.10 waterproofing membrane or ANSI A118.12 crack-isolation membrane where indicated or required by substrate conditions and TCNA method.

2.5 GROUT AND SEALANTS

A. Grout: Epoxy grout complying with ANSI A118.3 for wet, high-traffic, or chemical-exposure areas. Color as selected by Architect from manufacturer’s full range.

B. Sealant: Mildew-resistant, one-part silicone or urethane sealant suitable for tile movement joints, complying with Section 07 92 00 and matching grout color where exposed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with installation tolerances, flatness, moisture limits, curing, cleaning, and conditions affecting tile installation. Do not begin installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates in accordance with ANSI A108.01 and manufacturer instructions. Remove contaminants, laitance, sealers, curing compounds, coatings, and other bond-inhibiting materials.

B. Verify floor slopes to drains, transitions, and door clearances before layout. Notify Architect of conditions that would result in nonconforming cuts, irregular joint alignment, or ponding water.

3.3 INSTALLATION

A. Install tile in accordance with applicable ANSI A108 standards, TCNA Handbook methods, approved submittals, and manufacturer instructions. Use installation method appropriate for substrate, service conditions, tile size, and membrane requirements.

B. Lay out tile to provide balanced cuts, continuous joint alignment, and true lines. Center tile fields where practical and avoid cuts less than half tile unless approved.

C. Set porcelain floor tile with full mortar coverage required for service conditions; back-butter large-format tile as needed. Remove and reset tile not properly bonded, aligned, or supported.

D. Maintain consistent sanitary cove at floor-to-wall transitions, align base joints with floor joints where feasible, and provide factory corner pieces at inside and outside corners.

3.4 MOVEMENT JOINTS

A. Provide movement joints in tile work at perimeters, changes in plane, substrate movement joints, penetrations, and intervals recommended by TCNA EJ171. Do not bridge building movement joints with tile or setting materials.

3.5 GROUTING, CLEANING, AND PROTECTION

A. Grout tile after setting materials have cured sufficiently. Pack joints full, tool uniformly, and clean tile surfaces without scratching or damaging finish.

B. Protect completed tile work from traffic, impact, staining, freezing, and construction damage until final acceptance. Replace damaged, cracked, loose, or hollow-sounding tile and base units.

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Acoustical ceiling panels
2. Exposed grid suspension system
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
4. Perimeter Trim

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
4. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
5. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
6. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
8. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Material

B. ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality

C. NFPA 70 National Electrical Code

D. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.

B. Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with, or supported by the ceilings.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

1. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
2. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.
3. Fire Resistance: As follows tested per ASTM E119 and listed in the appropriate floor or roof design in the Underwriters Laboratories Fire Resistance Directory

B. Acoustical Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

C. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.6 PROJECT CONDITIONS

A. Space Enclosure:

1. Standard Ceilings: Do not install interior ceilings until space is enclosed and weatherproof; wet work in place is completed and nominally dry; work above ceilings is complete; and ambient conditions of temperature and humidity are continuously maintained at values near those intended for final occupancy. Building areas to receive ceilings shall be free of construction dust and debris.
2. HumiGuard Plus Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Products with HumiGuard Plus performance and hot dipped galvanized steel, aluminum or stainless steel suspension systems can be installed up to 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Cannot be used in exterior applications where standing water is present or where moisture will come in direct contact with the ceiling.

1.7 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Acoustical Panels: Sagging and warping
2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:

1. Acoustical panels: Ten (10) years from date of substantial completion
2. Suspension: Ten (10) years from date of substantial completion
3. Ceiling System: Thirty (30) years from date of substantial completion

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.8 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ceiling Panels:

1. USG.
2. Armstrong World Industries, Inc.
3. CertainTeed Corporation

B. Suspension Systems:

1. Armstrong World Industries, Inc.
2. Chicago Metallic
3. USG.

C. Perimeter Systems

1. Armstrong World Industries, Inc.
2. USG.
3. Chicago Metallic

2.2 ACOUSTICAL CEILING UNITS

A. ACT1: Acoustical Ceiling Tile

1. Armstrong Fine Fissured
2. Surface Texture: Fine
3. Color: White
4. Size: 24 in x 24 in
5. Edge Profile: Square Lay-In 15/16

6. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton 0.75
7. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton 45
8. Flame Spread: ASTM E 1264; Class A (UL)

2.3 METAL SUSPENSION SYSTEMS

A. Components:

1. Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.

    a. Structural Classification: ASTM C 635 Heavy Duty duty
    b. Color: Blizzard White and match the actual color of the selected ceiling tile, unless noted otherwise.
    c. Sustainability: Environmetal Product Declaration (EPD), Health Product Declaration (HPD)
    d. Acceptable Product: PRELUDE XL 15/16" Exposed Tee as manufactured by Armstrong World Industries

B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

D. Edge Moldings and Trim:

E. Accessories:

1. 15/16" Flush Act. to Drywall Transition Molding

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.3 INSTALLATION

A. Follow manufacturer installation instructions.

B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.

C. Suspend main beam from overhead construction with hanger wires spaced 4-0 on center along the length of the main runner. Install hanger wires plumb and straight.

D. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

E. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.

F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

END OF SECTION 095100

SECTION 096513
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rubber Base.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 RUBBER BASE (RB1 & RB2)

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product.

B. Product Standard: ASTM F 1861, Type TS (rubber).

1. Group: I (solid, homogeneous) .
2. Style and Location:
   a. Style B, Cove.

C. Height: As indicated on Drawings – RB1 (4 inch) – New Construction and Existing Casework Bases | RB2 (4.5 inch) – In Renovation/Flooring Replacement Areas

D. Lengths: Coils in manufacturer's standard length .

E. Outside Corners: Preformed .

F. Inside Corners: Preformed .

G. Colors and Patterns: Black

2.2 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until materials are the same temperature as space where they are to be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

3.3 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.
3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

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SECTION 096519
RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Vinyl composition floor tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of resilient floor tile.

1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

C. Samples: Full-size units of each color, texture, and pattern of floor tile required.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials , from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F , in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F .

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS (Refer to Interior Design Drawings for Product Information)

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

B. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 7 or more than 10 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement.

C. Refer to Alternate #2 for Moisture Mitigation Requirements.

D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096733 – GYMNASIUM WOOD FLOOR REFINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Work includes refinishing existing wood gymnasium flooring, including:

1. Inspection and preparation of existing wood floor.
2. Sanding of existing finish.
3. Repair of minor surface defects.
4. Repainting of game lines and graphics.
5. Application of gymnasium floor finish system.
6. Protection of completed work.

B. Related Sections:

1. Division 01 – General Requirements.

1.2 REFERENCES

A. MFMA (Maple Flooring Manufacturers Association) standards.

B. ASTM D4060 – Abrasion Resistance of Organic Coatings.

C. ASTM D3359 – Adhesion by Tape Test.

D. ANSI/MFMA Performance Standards for Maple Gymnasium Flooring.

1.3 SUBMITTALS

A. Product Data:

1. Sanding materials.
2. Wood sealers.
3. Court striping paint.
4. Finish coatings.

B. Court Layout Shop Drawings

1. Submit digitally prepared, scaled court layout drawings for review prior to commencement of striping work.
2. Shop drawings shall be based on field-verified dimensions of the gymnasium floor and shall include:

a. Overall gymnasium dimensions.
b. Basketball court layout.
c. Volleyball court layout.
d. Agility Markings – Dots and Ladders
e. Boundary lines and safety zones.
f. Dimensions and offsets of all court markings.
g. Line colors and line widths.
h. Color legend.
i. Drawings shall be prepared at a scale not smaller than 1/8 inch = 1 foot.

C. Samples:

1. Finish coating samples.
2. Striping color selections.

D. Maintenance Data:

1. Cleaning procedures.
2. Recommended maintenance schedule.

1.4 QUALITY ASSURANCE

A. Contractor shall be experienced in gymnasium wood floor refinishing with a minimum of five years documented experience.

B. Contractor shall have successfully completed at least five gymnasium floor projects of comparable size and complexity.

C. Perform work in accordance with MFMA recommendations.

1.5 PROJECT CONDITIONS

A. Building shall be enclosed and weather-tight.

B. Maintain ambient temperature between 60°F and 80°F.

C. Maintain relative humidity between 35 percent and 50 percent during refinishing operations and curing period.

D. Do not perform finishing operations under conditions that may adversely affect coating performance.

1.6 WARRANTY

A. Provide manufacturer's standard warranty for gymnasium floor coating system.

B. Contractor shall warrant workmanship for one year from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Gymnasium finishing systems by one of the following:

1. Bona Sport System.
2. Absco Sports Floors.
3. Tenacity Floor Finishes.
4. Robbins Sports Surfaces.
5. Hillyard Sports Floor Systems.
6. Approved equal.

2.2 FLOOR PREPARATION MATERIALS

A. Abrasives:

1. Professional-grade sanding belts and screens.
2. Grit sequence as recommended by finish manufacturer.

B. Wood Filler:

1. Compatible with existing maple flooring.
2. Sandable and stain resistant.

2.3 GAME LINE PAINT

A. Athletic Floor Paint:

1. Compatible with specified finish system.
2. Specifically formulated for maple gymnasium floors.
3. Colors as selected by Architect.

B. Existing layout shall be reproduced unless otherwise indicated on Drawings.

2.4 FINISH SYSTEM

A. Sealer:

1. Waterborne gymnasium floor sealer.
2. Manufacturer's standard system.

B. Finish Coating:

1. Two-component waterborne polyurethane gymnasium finish.
2. High abrasion resistance.
3. Slip-resistant performance complying with MFMA recommendations.
4. Gloss level: Satin unless otherwise indicated.

C. Performance Requirements:

1. Non-yellowing.
2. High resistance to black heel marks.
3. High resistance to scuffing and abrasion.
4. Suitable for athletic competition and physical education use.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine existing gym floor for:

1. Loose boards.
2. Damaged boards.
3. Excessive movement.
4. Moisture-related deficiencies.
5. Previous repair areas.

B. Notify Architect of conditions requiring repair beyond scope of refinishing.

3.2 PREPARATION

A. Remove equipment as necessary for refinishing operations.

B. Protect adjacent surfaces from dust and damage.

C. Remove existing finish by sanding in accordance with MFMA recommendations.

D. Vacuum and tack all surfaces prior to coating applications.

E. Fill minor cracks, nail holes, and surface imperfections.

3.3 REPAIRS

A. Replace damaged flooring boards as directed by Architect.

B. Repair isolated defects to provide uniform appearance.

C. Feather repaired areas into surrounding flooring.

3.4 COURT STRIPING AND GRAPHICS

A. General

1. Layout all court markings from approved digitally scaled shop drawings.
2. Verify dimensions in the field prior to application.
3. Coordinate all court locations to avoid conflicts between overlapping athletic markings.

B. Main Basketball Court

Repaint basketball court lines in accordance with current National Federation of State High School Associations (NFHS) requirements unless otherwise indicated.

Include all required markings, including:

a. Boundary lines.
b. Center circle.
c. Division line.
d. Free-throw lanes.
e. Three-point arcs.
f. Free-throw circles.
g. Restricted areas as applicable.

B. Side Practice Basketball Courts

Include partial markings, including:

h. Boundary lines.
i. Free-throw lanes.
j. Three-point arcs.

C. Volleyball Courts

1. Repaint volleyball court lines in accordance with current NFHS requirements unless otherwise indicated.
2. Include:
    a. Boundary lines.
    b. Center lines.

c. Attack lines.
d. Service zones.

D. Agility Markings (4 Sets)

1. Five-Spot Dot Drill
2. Agility Ladder Lines

F. Colors

1. Provide color schedule identifying each sport and corresponding line color.
2. Use contrasting colors to allow clear distinction between athletic functions.

3.5 FINISH APPLICATION

A. Apply sealer and finish coats in strict accordance with manufacturer's written instructions.

B. Minimum Finish System:

1. One coat gymnasium sealer.
2. Two coats waterborne polyurethane finish.

C. Apply coatings uniformly without streaks, puddles, lap marks, or visible defects.

D. Provide continuous finish over entire court surface.

3.6 FIELD QUALITY CONTROL

A. Finished floor shall exhibit:

1. Uniform sheen.
2. Consistent color.
3. Sharp game-line edges.
4. Smooth appearance free of sanding marks.
5. No visible dust contamination, bubbles, or coating defects.

3.7 PROTECTION

A. Restrict foot traffic during curing period.

B. Protect floor from construction activities.

C. Do not return equipment to floor until finish has fully cured in accordance with manufacturer's recommendations.

3.8 CLEANING

A. Remove debris and protective materials.

B. Clean floor using methods approved by finish manufacturer.

C. Leave floor ready for occupancy.

END OF SECTION 09 67 33

SECTION 096813
TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modular carpet tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples: For each exposed product and for each color and texture required.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials , from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Furnish 2% additional, of each type, color, and pattern installed.

1.4 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Lifetime.

PART 2 - PRODUCTS – REFER TO DRAWINGS

2.1 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Use Manufacturer Approved Adhesive as required by Warranty Terms. Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Concrete Slabs:

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
   a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
   c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

2. Refer to Alternate #2 for Moisture Mitigation

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer .

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

J. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

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SECTION 098500
SOUND TRANSMISSION CONTROL MATERIALS

Part 1 – GENERAL

1.0 Summary

A. Glass fiber acoustical insulation for interior walls, floors and ceilings in commercial Buildings.
B. Acoustical joint sealant
C. Sound Membrane

1.1 Related Products

A. Section 092216 Non-Structural Metal Framing
B. Section 042200 Unit Masonry
C. Section 079200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for non-acoustical applications.

1.2 References

A. American Society for Testing and Materials (ASTM)
    1. E84 Test Method for Surface Burning Characteristics
    2. E90 Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
    3. E96 Test Method for Water Vapor Transmission of Materials
    4. E136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees F. (unfaced)
    5. C423 Test Method for Sound Absorption and the Sound Absorption Coefficient by the Reverberation Room Method
    6. C665 Standard Specification for Mineral Fiber Blanket Insulation for Light Frame Construction and Manufactured Housing.

1.3 Submittals

A. Product Data: Submit product literature, installation instructions and product samples for all products.
B. Samples for initial selection of all joint sealant that will be visible.

    a. Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
    b. Acoustical-Joint-Sealant Schedule: Include the following information:

        i. Joint-sealant application, joint location, and designation.
        ii. Joint-sealant manufacturer and product name.
        iii. Joint-sealant formulation.
        iv. Joint-sealant color.

1.4 Delivery, Storage and Handling

A. Protect insulation from physical damage and from becoming wet, soiled or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation
B. Label for insulation packages to include material name, production date and/or product code.

1.5 Limitations

A. Do not use unfaced insulation in exposed applications where there is potential for skin contact and irritation.
B. Kraft facings will burn and must not be left exposed. The facing must be in substantial contact with the unexposed surface of the ceiling, wall or floor finish.

Part 2 – PRODUCTS

2.1 Manufacturer

A. Owens Corning
B. Sika
C. Commercial Acoustics
B. Approved equals

2.2 QuietZone Acoustic Batt Insulation

A. Type I: Unfaced glass fiber insulation complying with ASTM C 665 and ASTM E 136.
B. Type II: Kraft faced glass fiber insulation complying with ASTM C 665.
C. Surface burning characteristics

1. Unfaced Insulation
   Maximum flame spread: 10
   Maximum smoke developed; 10
2. Kraft faced Insulation
   Maximum flame spread: not rated
3. Maximum smoke developed: not rated

D. Combustion Characteristics: Unfaced insulation passes ASTM E 136 test.
E. Dimensional Stability: Linear stability less than 0.1%.

2.3 Acoustical Sealant

A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90.
B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
C. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

D. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
E. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

2.3 Sound Membrane

A. Basis of Design: Commercial Acoustics Wall Blokker (products of comparable performance will be considered) – Applied to both sides of stud walls in new Office Area.
   1. 1 lb/sf EVA flexible sound membrane
   2. Stand-alone membrane STC rating of 26.
   3. 1/8” thickness.

Part 3 – EXECUTION

3.1 Inspection

A. Examine the areas and conditions under which work of this section will be installed. Verify that adjacent materials are dry and ready. Verify that electrical and mechanical services within walls have been inspected and tested. Verify that project drawings comply with installation requirements.
B. Provide written report listing conditions detrimental to the performance of work in this section. Do not proceed with installation until unsatisfactory conditions have been resolved.

3.2 Preparation

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.
B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 Installation – Acoustical joint sealants

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
C. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written recommendations for closing off sound-flanking paths

around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

D. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.3 Installation – Insulation

A. Comply with manufacturer's instruction for particular conditions of installation in each case.
B. Between studs Friction-fit unfaced insulation between studs after cover material has been installed on one side of the cavity. When faced insulation is used, staple attachment flanges to face or side (preferred) of stud every 8 to 12 inches to hold in place.

3.4 Installation – Vapor retarder

A. This insulation is for interior wall use only.
B. The Kraft paper for this product is NOT a vapor retarder.
C. NOT recommended for exterior walls.

3.5 Cleaning

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.6 Material Storage and Protection

A. Protect insulation from damage and from becoming wet before, during and after installation.
B. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 098500

SECTION 099113
EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Concrete.
2. Concrete masonry units (CMUs).
3. Steel and iron.
4. Galvanized metal.
5. Gypsum board.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
3. Section 055116 "Metal Floor Plate Stairs" for shop priming metal floor plate stairs.
4. Section 055119 "Metal Grating Stairs" for shop priming metal grating stairs.
5. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, in accordance with ASTM D523.

B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, in accordance with ASTM D523.

C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, in accordance with ASTM D523.

D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, in accordance with ASTM D523.

E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, in accordance with ASTM D523.

F. MPI Gloss Level 7: More than 85 units at 60 degrees, in accordance with ASTM D523.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams; products as designated in the Finish Schedule or comparable product by one of the following:

1. Behr Process Corporation.
2. Benjamin Moore Company.
3. PPG Paints

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Finish Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMUs): 12 percent.
3. Gypsum Board: 12 percent.

C. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and re-prime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:
   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Pipe hangers and supports.
   d. Metal conduit.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System:
   a. Prime Coat: Latex, exterior.
      1) Sherwin-Williams: Loxon Concrete and Masonry Primer, A24 Series (5.3 – 8.0 mil wet, 2.1-3.2 mil dry)
   b. Intermediate Coat: Latex, exterior, matching topcoat.
   c. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4).
      1) Sherwin-Williams: A-100 Exterior Acrylic Latex Satin, A82 Series

B. Concrete Substrates, Traffic Surfaces:

1. Latex Floor Paint System:
   a. Prime Coat: Floor paint, latex, matching topcoat.
      1) Sherwin-Williams: ArmorSeal Tread-Plex , Semi Gloss, B90 Series
   b. Topcoat: Floor paint, latex, low gloss (maximum MPI Gloss Level 3).
      1) Sherwin-Williams: ArmorSeal Tread-Plex , Semi Gloss, B90 Series

C. CMU Substrates:

1. Latex System:

    a. Prime Coat: Block filler, latex, interior/exterior.
        1) Sherwin-Williams: PrepRite Block Filler, B25 Series (16 mil wet, 7.7 mil dry)
    b. Intermediate Coat: Latex, exterior, matching topcoat.
    c. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4).
        1) Sherwin-Williams: A-100 Exterior Acrylic Latex Satin, A82 Series

D. Steel and Iron Substrates:

1. Water-Based Light Industrial Coating System:
    a. Prime Coat: Primer, rust inhibitive, metal.
        1) Sherwin-Williams: Pro Industrial Pro Cryl Universal Primer, B66 Series (5-10 mil wet, 1.8-3.6 mil dry)
    b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
    c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3).
        1) Sherwin-Williams: Pro Industrial Acrylic Eg-Shel, B66 Series (6-12 mil wet, 2.1-4.2 mil dry).

E. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System:
    a. Prime Coat: Primer, galvanized, cementitious.
        1) Sherwin-Williams: Pro Industrial Pro Cryl Universal Primer, B66 Series (5-10 mil wet, 1.8-3.6 mil dry)
    b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
    c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3).
        1) Sherwin-Williams: Pro Industrial Acrylic Eg-Shel, B66 Series (6-12 mil wet, 2.1-4.2 mil dry).

END OF SECTION 099113

SECTION 099123
INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Clay masonry.
3. Concrete masonry units (CMUs).
4. Steel and iron.
5. Galvanized metal.
6. Gypsum board.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, in accordance with ASTM D523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, in accordance with ASTM D523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, in accordance with ASTM D523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, in accordance with ASTM D523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, in accordance with ASTM D523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, in accordance with ASTM D523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, in accordance with ASTM D523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams products as designated in the Finish Schedule or comparable products by one of the following:

1. Behr Process Corporation.
2. Benjamin Moore Company.
3. PPG Paints

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Finish Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMUs): 12 percent.
3. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

A. Apply paints in accordance with manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedule may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:
   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Pipe hangers and supports.
   d. Metal conduit.

2. Paint the following work where exposed in occupied spaces:
   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Pipe hangers and supports.
   d. Metal conduit.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System:
    a. Prime Coat: Latex, interior, matching topcoat.
        1) Sherwin-Williams: Loxon Concrete and Masonry Primer, A24 Series (5.3 – 8.0 mil wet, 2.1-3.2 mil dry)
    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat: Latex, interior (MPI Gloss Level 2).
        1) Sherwin-Williams: ProMar 200 Zero VOC Interior Latex Eg-shel, B20 Series (4 mil wet, 1.7 mil dry)

2. High-Performance Architectural Latex System:

    a. Prime Coat: Primer, alkali resistant, water based.
        1) Sherwin-Williams: Loxon Concrete and Masonry Primer, A24 Series (5.3 – 8.0 mil wet, 2.1-3.2 mil dry)
    b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
    c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2).
        1) Sherwin-Williams: Pro Industrial Pre Catalyzed Waterbased Epoxy Eg-shel, K45 Series

B. Concrete Substrates

1. Polished Concrete Stain:

    a. Prep: H&C Etching Solution
    b. Stain: H&C Semi Transparent Stain
        1) Colors as selected on drawings.

C. CMU Substrates:

1. Latex System:

a. Block Filler: Block filler, latex, interior/exterior.
1) Sherwin-Williams: PrepRite Block Filler, B25 Series (16 mil wet, 7.7 mil dry)
b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior (MPI Gloss Level 2).
1) Sherwin-Williams: ProMar 200 Zero VOC Interior Latex Eg-shel, B20 Series (4 mil wet, 1.7 mil dry)

2. High-Performance Architectural Latex System:

a. Prime Coat: Primer, alkali resistant, water based.
1) Sherwin-Williams: PrepRite Block Filler, B25 Series (16 mil wet, 7.7 mil dry)
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2).
1) Sherwin-Williams: Pro Industrial Pre Catalyzed Waterbased Epoxy Eg-shel, K45 Series

D. Steel Substrates:

1. Latex over Shop-Applied Quick-Drying Shop Primer System:

a. Prime Coat: Primer, rust inhibitive, metal.
1) Sherwin-Williams: Pro Industrial Pro Cryl Universal Primer, B66 Series (5-10 mil wet, 1.8-3.6 mil dry)
b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior (MPI Gloss Level 2).
1) Sherwin-Williams: Pro Industrial Acrylic Eg-Shel, B66 Series (6-12 mil wet, 2.1-4.2 mil dry)

2. Acrylic Dry-Fall System:
a. Prime Coat: Primer, quick dry.
1) Sherwin-Williams: Waterborne Acrylic Dryfall, B42 Series (6-9 mil wet, 1.5-2.3 mil dry)
b. Topcoat: Dry fall, flat.
1) Sherwin-Williams: Waterborne Acrylic Dryfall, B42 Series (6-9 mil wet, 1.5-2.3 mil dry)

E. Galvanized-Metal Substrates:

1. Latex System:
a. Prime Coat: Primer, galvanized, cementitious.
1) Sherwin-Williams: Pro Industrial Pro Cryl Universal Primer, B66 Series (5-10 mil wet, 1.8-3.6 mil dry)
b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior (MPI Gloss Level 2).

1) Sherwin-Williams: Pro Industrial Acrylic Eg-Shel, B66 Series (6-12 mil wet, 2.1-4.2 mil dry)

F. Gypsum Board Substrates:

1. Latex over Latex Sealer System:
   a. Prime Coat: Primer sealer, latex, interior.
      1) Sherwin-Williams: ProMar 200 Zero VOC Interior Latex Primer, B28 Series (4 mil wet, 1.0 mil dry)
   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior (MPI Gloss Level 2).
      1) Sherwin-Williams: ProMar 200 Zero VOC Interior Latex Eg-shel, B20 Series (4 mil wet, 1.7 mil dry)

END OF SECTION 099123

SECTION 102800
TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Toilet accessories.
B. Mirrors
C. Attachment hardware.
D. Coordinate the work of this Section with the placement of internal wall reinforcement to receive anchor attachments.

1.2 REFERENCES

A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible To and Usable by Physically Handicapped People.
B. ANSI/ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strips.
C. ANSI/ASTM A366 - Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
D. ANSI/ASTM A386 - Zinc Coating (Hot-Dip) on Assembled Steel Products.
E. ANSI/ASTM B456 - Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
F. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
G. ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
H. NEMA LD-3 - High Pressure Decorative Laminates.
I. ADA - Americans with Disabilities Act
J. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physical Handicapped People.

1.3 SUBMITTALS

A. Provide Product Data on accessories describing size, finish, details of function, attachment methods.
B. Submit two samples chips of each specified color and finish.
C. Submit manufacturer's installation instructions for each product.

1.4 REGULATORY REQUIREMENTS

A. Conform to applicable code for installing work in conformance with ANSI A117.1 and ADA.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – TOILET ROOM ACCESSORIES

A. Bobrick
B. American Specialties Inc.
C. Bradley
D. McKinney
E. Manufacturers of equivalent products submitted and approved in accordance with Section 016000 - Product Requirements.

2.2 MATERIALS

A. Sheet Steel: ANSI/ASTM A366.
B. Stainless Steel Sheet: ASTM A167, Type 304.
C. Tubing: ASTM A269, stainless steel.
D. Adhesive: Contact type, waterproof.
E. Fasteners, Screws, and Bolts: Hot dip galvanized, tamperproof.
F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.3 FABRICATION

A. Weld and grind smooth joints of fabricated components.
B. Form exposed surfaces from single sheet of stock, free of joints.
C. Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
D. Back paint components where contact is made with building finishes to prevent electrolysis.
E. Shop assemble components and package complete with anchors and fittings.
F. Provide steel anchor plates, adapters, and anchor components for installation.
G. Hot dip galvanize exposed and painted ferrous metal and fastening devices.

2.4 FACTORY FINISHING

A. Galvanizing: ANSI/ASTM A123 and A386 to 1.25 oz/sq. yd.
B. Shop Primed Ferrous Metals: Pre-treat and clean, spray apply one coat primer and bake.
C. Enamel: Pre-treat to clean conditions, apply one coat primer and a minimum of two coats electrostatic baked enamel.
D. Chrome/Nickel Plating: ANSI/ASTM B456, Type SC 2 satin finish.
E. Stainless Steel: No. 4 satin luster finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that site conditions are ready to receive work.
B. Beginning of installation means acceptance of existing conditions.
C. Deliver inserts and rough-in frames to site at appropriate time for building-in.
D. Provide templates and rough-in measurements as required.

E. Verify exact location of accessories for installation.

3.2 INSTALLATION

A. Install fixtures, accessories and items in accordance with manufacturers' instructions.
B. Install plumb and level, securely and rigidly anchored to substrate.
C. Protect products from damage caused by subsequent construction activities.
D. Field repair of damaged product finishes is prohibited; replace products having damaged finishes caused by subsequent construction activities.
E. Locate toilet accessories at heights and locations required for compliance with local accessibility regulations and the Americans with Disabilities Act.

3.3 SCHEDULE

Bobrick and American Specialties Inc. is used as a quality standard set to be expected on all items of this Section. Provide accessories where indicated on floor plan. The following accessories are:

A. Mirrors: 1/4" float/plate glass with stainless channel trim, 18” x 36”. Provide 1 at each sink location.

1. Bobrick Series B-165.

B. Sanitary Napkin Disposal. Provide 1 at each toilet location.

1. Bobrick Series B-270.

C. Grab Bars: 1 1/2” O.D. (minimum) stainless steel, with peened surface, with concealed fasteners. Length as indicated on plans. Provide at ADA toilet locations.

1. Bobrick Series.
2. Provide anchors as required.

D. Janitor’s utility shelf, 302/304 stainless steel, 18 gage shelf with 1-1/2 inch return edge; 18 gage mounting brackets welded to shelf; 3 spring loaded rubber cam mop and broom holders and 2 rag hooks, 8 inches deep by 30 inches long. Provide 1 at each mop sink.

1. Bobrick Series B-224.

E. Tissue Dispenser:

1. Provided by Owner and installed by Contractor. Provide 1 minimum at each toilet location.

F. Soap Dispenser:

1. Provided by Owner and installed by Contractor. Provide 1at each sink location.

G. Coat Hooks: Heavy duty clothes hook. Provide (2) on the back of each single user toilet room doors. Mount at 47” and 36”

1. Single Prong: Bobrick Series B-211.

H. Paper Towel Dispenser:

1. Provided by Owner and installed by contractor. Provide 1 in each single toilet room.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguisher.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
2. Show location of knockouts for hose valves.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 FIRE-PROTECTION CABINET

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. Babcock-Davis
2. Guardian Fire Equipment, Inc
3. Larsen's Manufacturing Company

B. Fire-Protection Cabinet Type: Suitable for fire extinguisher.

C. Cabinet Construction: Nonrated.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from **0.043-inch-** thick cold-rolled steel sheet lined with minimum **5/8-inch-** thick fire-barrier material. Provide factory-drilled mounting holes.

D. Cabinet Material: Stainless steel sheet.

1. Shelf: Same metal and finish as cabinet.

E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

G. Cabinet Trim Material: Same material and finish as door.

H. Door Material: Stainless steel sheet.

I. Door Style: Center glass panel with frame.

J. Door Glazing: Tempered float glass (clear).

K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard.
2. Provide manufacturer's standard hinge, permitting door to open 180 degrees.

L. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.

3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

    a. Identify fire extinguisher in fire-protection cabinet with the words "[**FIRE EXTINGUISHER**]

        1) Location: Applied to cabinet glazing.
        2) Application Process: Decals.
        3) Lettering Color: Red.
        4) Orientation: Vertical.

4. Alarm: Manufacturer's standard alarm that actuates when fire-protection cabinet door is opened and that is powered by batteries.

M. Materials:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.

    a. Finish: ASTM A480/A480M No. 4 directional satin finish,.

2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.
5. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum **1/2 inch** thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

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

3.2 PREPARATION

A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION OF FIRE-PROTECTION CABINETS

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at height indicated below:

1. Fire-Protection Cabinet Mounting Height: 42 inches above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification:

1. Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that

integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

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SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers.

B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Babcock-Davis
    b. Guardian Fire Equipment, Inc
    c. Kidde; Carrier Global Corporation
    d. Larsen's Manufacturing Company

2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
3. Valves: Manufacturer's standard.
4. Handles and Levers: Manufacturer's standard.
5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Steel Container : UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

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

3.2 INSTALLATION

A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

1. Mounting Height: Top of fire extinguisher to be at 42 inches above finished floor.

END OF SECTION 104416

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1. General
   1.1. Section Includes
      A. Musical Instrument Storage Casework.
   1.2. RELATED SECTIONS
      A. Division 01 - General Requirements.
      B. Section 06 10 00 - Rough Carpentry.
      C. Section 09 65 13 - Resilient Base and Accessories.
   1.3. REFERENCES
      A. Audio Engineering Society (AES):
         1. AES-4id - AES information document for room acoustics and sound reinforcement systems - Characterization and measurement of surface scattering uniformity.
      B. American National Standards Institute (ANSI):
         1. ANSI A208.1 - Particleboard.
         2. ANSI A208.2 – Medium Density Fiberboard (MDF) Standard for Interior Applications.
      C. American Society of Civil Engineers (ASCE):
         1. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
      D. ASTM International (ASTM):
         1. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
         2. ASTM E488 - Standard Test Methods for Strength of Anchors in Concrete and Elements.
         3. ASTM E795 - Practices for Mounting Test Specimens During Sound Absorption Tests.
      E. Builders Hardware Manufacturers Association (BHMA):
         1. ANSI/BHMA A156.9 - Cabinet Hardware.
      F. California Air Resources Board (CARB):
         1. California 93120 - Formaldehyde Emissions Phase I.
      G. GREENGUARD Environmental Institute (GEI):
         1. GREENGUARD certified low-emitting products.
      H. International Electrotechnical Commission (IEC):
         1. Requirements for listing and labeling of products.
      I. National Electrical Manufacturers Association (NEMA):
         1. NEMA LD 3 - High-Pressure Decorative Laminates.
      J. Underwriter's Laboratory (UL):
         1. UL 969 - Standard for Marking and Labeling Systems.
      K. U.S. Department of Commerce, National Institute of Standards and Technology (NIST):
         1. DOC PS 1 - U.S. Product Standard for Construction and Industrial Plywood.
   1.4. SUBMITTALS
      A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
      B. Product Data: Manufacturer's data sheets on each product to be used, including:
         1. Preparation instructions and recommendations.
         2. Rated capacities, construction details, material descriptions, dimensions of individual components, profiles, and finishes.
         3. Independent Testing and Certification of fully assembled cabinet is required.
            A. Fully assembled cabinet (system) acoustical performance.
            B. Waterfall Grille door acoustical performance.

4. Delivery, storage, handling, and installation instructions and recommendations.
5. Assembly and installation instructions.
6. Description of specialties and accessories.
7. Maintenance instructions and recommendations.

C. Shop Drawings: Project-specific Drawings indicating details of storage, layout, and installation, including:

1. Submit component and project-specific installation Drawings, cut sheets, and schedules showing all information necessary to fully explain design features, appearance, function, fabrication, installation, and use of system components in all phases of operation.
2. Show components, assemblies, connections, attachments, and anchorage.
3. Show fabrication and installation details. Distinguish between factory and field work.
4. Include clearances, spacing, and relation to adjacent construction in plan.
5. Include plans, elevations, sections, attachments, and work by other trades.
6. Show system layouts, room locations, clearances, spacing, and relationship to adjacent construction.
7. Show hardware, trim and accessories.
8. Indicate seismic bracing and fastening requirements.
9. Submit Shop Drawings for approval before beginning any fabrication, installation, or erection.

D. Product Schedule:

1. Use designations indicated in Drawings.
2. Include room locations, dimensions, accessories, finishes, and project-specific notes.

E. Verification Samples:

1. Exposed Finishes and Finish Materials: For each color and finish of each exposed component.

F. Closeout Submittals:

1. Operation and Maintenance Data: For adjusting, repairing, cleaning, and replacing components and accessories.
2. Warranty: Submit Manufacturer's warranty.

1.5. QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 years’ experience in design and manufacturing of similar products on projects of similar size, scope, and complexity, and with production capacity to meet construction and installation schedule.

B. Installer Qualifications: Manufacturer's authorized representative, trained and approved for installation of units required for this project.

C. Source Limitations: Obtain all products through a single source from a single approved Manufacturer providing a comprehensive material and installation package.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in Manufacturer's original unopened containers with Manufacturer's labels attached.

B. Do not deliver components until spaces to receive them are clean, dry, and ready for their installation. Ship to jobsite only after rough-in, painting, and other finishing work have been completed, and installation areas are ready to accept work.

C. Handle and install materials to avoid damage.

1.7. PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install materials until spaces are enclosed and weather-tight, wet work in spaces is complete and dry.

2. HVAC system must be operating and maintaining ambient temperature at occupancy levels during the remainder of the construction period.

B. Field Measurements: Contractor verify field measurements indicated on Shop Drawings. Where measurements are not possible, provide control dimensions and templates.

1. Coordinate installation and location of blocking and supports as requested.
2. Verify openings, clearances, storage requirements, and other dimensions relevant to installation and final application.

C. Coordination:

1. Ensure that products of this Section are supplied to affected trades in time to prevent interruption of construction progress.
2. Coordinate installation of storage specialties to ensure proper installation and operation of each component.
3. Coordinate clearances required for all equipment.
4. Coordinate installation of blocking and supports in frame wall assemblies under work of other Sections where required.

1.8. WARRANTY

A. Special Warranty: Submit Manufacturer's written warranty to repair or replace components that fail in materials or craftsmanship during warranty period.

B. Failures include, but are not limited to the following:

1. Fracturing or breaking of unit components resulting from normal wear and tear and normal use other than vandalism.
2. Delamination or other failures of bonding or assembly.
3. Warping of components not resulting from leaks, flooding, or other uncontrolled moisture or humidity.
4. Faulty operation of hardware.

C. Exclusions:

1. Damage from deliberate destruction and vandalism is excluded.

D. Warranty Period (Specialty Casework): 10 years from the date of Substantial Completion.

2. PRODUCTS

2.1. MANUFACTURERS

A. Acceptable Manufacturer: Wenger Corporation, Owatonna, MN

1. Phone: 800-493-6437
2. Email: maggie.kramer@wengercorp.com
3. Web: www.wengercorp.com

B. Requests for substitutions shall be considered in accordance with the provisions of Section 01 60 00 - Product Requirements.

1. Approval of Comparable Products: Submit the following in accordance with project substitution requirements, within the time period allowed for substitution review.

A. Product data, including certified independent test data indicating compliance with requirements for acoustic performance.

B. Independent Testing and Certification of fully assembled cabinet is required.

1. Fully assembled cabinet (system) acoustical performance.
2. Waterfall Grille door acoustical performance.

C. Samples of each type of product specified, including but not limited to the following:

1. Door and casework panels.
2. Grille doors.
3. Hinges with through-bolting hardware.
4. Latches with through-bolting hardware.

D. Project References: Minimum of 5 installations, not less than 5 years old, with Owner contact information.
E. List of successful installations of similar products available for evaluation by the Architect.
F. Sample warranty.

2. Approved Manufacturers shall meet separate requirements of submittals.

2.2. MATERIALS

A. Materials to Meet Sustainable Design Requirements:

1. No Added Urea Formaldehyde Products: Provide products made with composite products and adhesives with no urea formaldehyde added.
2. FSC Certified Wood Products: Provide music education storage casework made with wood from certified sources.
3. GREENGUARD Indoor Air Quality Certified and GREENGUARD Children & Schools Certified.

B. Particleboard: To ANSI A208.1, minimum 43 pounds per cubic foot (689 kg/m3) density.
C. Fire Rated Particle Board: ANSI A208.1, minimum 45 pounds per cubic foot (720 kg/m3) density ASTM E-84 class 1.
D. Plywood: APA standards PS1-98 Section 5.7.4 or 5.7.1, or ANSI /HPVA HP-1-2004 panel provided with HDF skins to prevent grain telegraphing.
E. Particleboard Thermoset Panels: Particleboard panel with no formaldehyde added, 3/4-inch (19 mm) thick, finished with thermally-fused polyester surfacing on both sides, meeting performance requirements of laminate finish and edge banding described herein.
F. Laminate Finish: Composite, of thickness indicated, finished with thermally fused anti-microbial polyester surfacing on both sides, meeting performance properties of NEMA LD3 for VGS grade, with heat-bonded, radiused, 3 mm thick extruded PVC edge banding.

1. Surface Abrasion Resistance: Taber Wheel, 400 cycles, for solid colors.

G. PVC Edge Banding: LMA EDG-1, radiused PVC extrusions, 3 mm thick, heat-bonded.
H. Polyethylene Shelves: High-density, 1-piece, blow-molded or polyethylene, with radiused front edge. Provide material with integrated color throughout so as not to show scratches.
I. Anchors and Fasteners:

1. Factory Provided: Material, type, and size recommended by Manufacturer for secure anchorage to substrate.
2. Field Installed: Manufacturer-recommended fasteners furnished by Contractor as required for substrate and project requirements.

2.3. MUSICAL INSTRUMENT STORAGE CASEWORK

A. Provide a modular instrument and accessories storage cabinet system.

1. System shall include integral bases, adjustable levelers, and through-bolting fastening in the sizes and configurations shown on the Drawings.
2. System shall include interior lining of sound-absorbent material to provide sound absorption and noise reduction properties and integrate a door design to minimize cubic volume loss and reduce vibration. No Substitution Allowed.

B. Basis of Design:

1. Wenger Corporation, Owatonna, MN
2. www.wengercorp.com.
3. Wenger AcoustiCabinets

C. General Requirements:

1. All cabinets shall be designed to store a variety of instruments in fixed-size compartments.

2. Cabinet Configurations: Provide cabinets in the size and configurations shown on the Drawings from manufacturer's standard cabinet configurations.
3. Storage Casework Component Load Capacities:
    A. Storage Casework Wire-Grille Door Hinge: Each weld capable of resisting 400-pound-foot (1779 N) pull test without visible damage or permanent deformation.
4. Panel Edge Banding: Provide 3 mm thick, heat-bonded, with radiused and profiled edges and corners.
5. Carcass joinery includes lag screws powder coated to match substrate.
6. Back panel: 7/32-inch (5.6 mm) reinforced with 3/4-inch (19 mm) stretcher panels held in a dado groove and lag screwed in place.

D. Acoustic Requirements:
1. Acoustically enhanced instrument storage casework finished with interior lining of sound-absorbent material providing sound absorption and noise reduction properties.
2. Sound Absorption Average: Minimum SAA of 0.80, based upon sound absorption coefficient for twelve one-third octave bands from 200 to 2500 Hz, inclusive, with a minimum Noise Reduction Coefficient (NRC) of 0.75, per ASTM C 423 and ASTM E 795 for fully assembled cabinet (system) and waterfall grille door.
3. Acoustical Performance: Comply with Manufacturer's published sound absorption data. No Substitutions

E. Fabrication:
1. Fabricate components square and rigid. Make exposed metal safe to touch and free of sharp ends or burrs.
2. Form frames, panels, doors, and accessories from one-piece, or one rigid assembly, unless specifically shown on Shop Drawings.
3. Factory preassemble metal components by welding all joints, and connections; with no bolts, nuts, screws, or rivets used in assembly, except as required for knock-down shipping and attachment to mounting surfaces.

F. Components:
1. Side Panels and Divider Panels:
    A. Particleboard thermoset panel with no urea formaldehyde added, 3/4-inch (19 mm) thick.
    B. Side panels machined to accept unit-to-unit through-bolting.
2. Shelving:
    A. Size shelves with an adequate gap between shelving and casework side panels to allow air movement inside the casework.
    B. Over 19 Inches (483 mm) wide: Provide tubular steel supports.
    C. Up to 27 Inches (686 mm) wide: Removable molded polyethylene shelf, with impact-resistant, radiused front edge, mounted to cabinet wall with self-locking clip.
    D. Over 27 Inches (686 mm) wide: Removable formed polyethylene shelf, ribbed, with high-impact-resistant, radiused front edge, supported by steel tube frame.
3. Cabinet Doors:
    A. Waterfall Grille Doors - Acoustic:
        1. 5/16 and 1/4-inch (7.9 and 6.3 mm) diameter with full 360-degree welds at T-joints.
        2. Vertical grille rods shall be shaped in a non-linear pattern.
        3. Provide compartment height and full-height doors as indicated in the Drawings.
4. Hardware
    A. Butt Hinges:

1. 2-3/4 inches (70 mm), 5-knuckle steel hinges made from 0.09-inch (2.29 mm) thick metal, ANSI/BHMA A156.9, Grade 1, with powder-coated finish, through-bolting to door and side panels, and welded to grille door frames.
2. Provide 2 hinges on compartment doors, and 4 hinges on full-height doors.

B. Slide Latch:

1. 0.105-inch (2.67 mm) min. thickness steel, with padlock eye, powder-coat finish, through-bolted to panel door and side panel, and welded to grille door frames.
2. Provide latches that secure without padlock. Padlocks furnished by Owner.
3. Provide clear plastic label holder for use with standard-size labels; number system available for user to print.

C. Panel Connectors: 1/4-20 x 1.77-inch (45 mm) panel connectors, with steel thread inserts, powder coated to match panels.

D. Cabinet Levelers: Leveling glides with 3/8-inch (9.5 mm) diameter threaded steel rod in steel corner brackets, minimum two each per cabinet side, accessible from within unit, and concealed in completed installation.

E. Fasteners: Manufacturer-recommended fasteners as required for casework substrate and project performance requirements, consisting of one or more of the following:

1. Sheet Metal Screws: SAE J78, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
2. Wood Screws: ASME B18.6.1.
3. Expansion Anchors in Concrete and Concrete Masonry Units: Carbon-steel, zinc-plated.
4. Provide hardware to anchor the cabinets to the wall and to adjacent casework.

G. Cabinet Assemblies:

H. Accessories:

1. Filler Panels and Closure: 3/4-inch (19 mm) thick particleboard thermoset panels with no urea formaldehyde, with finish that matches cabinet. Provide the following, cut to fit field conditions, where indicated:

A. Wall filler between cabinet side and wall.

B. Top filler between cabinet top and wall.

C. Top of cabinet closure panel between cabinet and finished ceiling or soffits.

D. Finished back panel for exposed cabinet backs.

I. Finishes:

1. Casework Panel Color: As selected by Architect from Manufacturer's standard colors.
2. Steel Sheet, Steel Wire, and Exposed Fasteners Finish: Urethane-based electrostatic powder coating, as selected by Architect from Manufacturer's standard colors.

3. EXECUTION

3.1. EXAMINATION

A. Examine installation areas and mounting surfaces with the Installer present for compliance with the Manufacturer's installation tolerances, including required clearances, floor level, location of blocking and anchoring reinforcements, and other existing conditions that may affect installation or performance.

3.2. CASEWORK INSTALLATION

A. Install plumb, level, and true. Install in accordance with Manufacturer's recommendations and approved submittals.

B. Install seismic bracing and fastening in accordance with approved shop Drawings.

C. Install hardware uniformly and precisely. Set hinges snug and flat. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

D. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind and close with uniform reveals.

3.3. CLEANING AND PROTECTION

A. Repair or replace defective work as directed by Architect upon inspection.

B. Clean surfaces. Touch up marred finishes or replace damaged components that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by Manufacturer.

3.4. DEMONSTRATION

A. Turn over keys, tools, and any operating/maintenance instructions.

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SECTION 116623
ATHLETIC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. The Work required under this Section consists of providing sports & physical education equipment items, accessories and necessary mounting, and installation hardware.

1.2 SUBMITTALS

A. Submit in accordance with Division 1 requirements.

B. Shop drawings shall indicate the model number, type of material, gauges or thickness of metal, finishes and details of construction, and attachment. Provide layout of gymnasium showing location dimensions for each piece of equipment.

C. Submit warranties as specified herein.

1.3 PROJECT CONDITIONS

A. Loose items of equipment shall be turned over to the Owner after un-packaging or uncrating, and checking for proper type, material, size and fit of each accessory. Obtain receipt from Owner for items turned over. No claim may be made for items turned over to the Owner without obtaining a receipt.

1.4 COORDINATION

A. Coordinate with Divisions 15 and 16 contractors for installation of the physical education equipment. Also coordinate with the Architect for exact locations.

1.5 WARRANTY

A. Provide manufacturer's standard warranty on all sports & physical education equipment from the date of substantial completion as stated in this specification.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Products of the following manufacturers are acceptable, providing their products equal or exceed the quality specified. Minor differences in construction and products are recognized to exist and may be acceptable. These variations must be submitted to the architect at least 10 days prior to bid due date. Acceptance will be established by addendum.

1. Basis of Design: Performance Sports Systems, Noblesville, Indiana
2. Porter Athletic, Broadview, IL
3. Jaypro Sports Equipment, Waterford, CT

2.2 GENERAL

A. Equipment shall be provided complete as per manufacturer's standard catalog description and specifications for the numbers indicated in the schedule. Equipment to be permanently installed shall be complete and ready for use.

B. Materials and finishes shall be non-corrosive in type and quality of finish noted or as a part of the manufacturer's printed description or specifications.

PROTECTIVE WALL PADDING

A. Model No. 4130 Class “A” Fire Rated Neoprene Foam Wall Padding by Performance Sports Systems, Noblesville, IN.

B. Panel hights as shown on drawings. Panels of 2’’ thick CR Safguard fire retardant neoprene foam meeting ASTM E84 with Class A rating flame spread index of 25 or less, and smoke development index of 450 or less. Each panel shall be covered with 14 oz. polyester reinforced laminated vinyl and cemented to 7/16’’ OSB exterior grade wood panels with one-inch nailing margins at top and bottom (for securing panels to wall). Available in fifteen (15) standard colors (color to be determined by Architect). All cutouts in panels shall be made in field to fit job conditions.

C. Vinyl flammability rated as self-extinguishing by the California State Fire Code.

END OF SECTION 11 6623

SECTION 122413
ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single rollers. Provide at:
   a) Indicated at window types per window schedule

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of shadeband material, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Draper Inc.
2. Hunter Douglas Contract.
3. Lutron Electronics Co., Inc.
4. MechoShade Systems, Inc.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Manufacturer's standard.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Clip, jamb mount.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of interior face of shade.

2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.

F. Shadecloth: Draper, Inc., (Phifer Sheer Weave Series): Non-raveling vinyl/fiberglass mesh, PVC free. Fabric thickness 0.025 inches, weight 16.4 oz./sq.yd.

1. Phifer Sheer Weave, Interior Sun Control Fabric, Basic 3% Openness.
a. Color: P05 White/Platinum

G. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 3 inches.

2. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.

a. Closure-Panel Width: 2 inches.

3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

b. ROLLER SHADE FABRICATION

i. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

ii. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

iii. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4 , provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Skylight Shades: Provide battens and seams at uniform spacings along shadeband as required to ensure shadeband tracking and alignment through its full range of movement without distortion or sag of material.
3. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

H. EXECUTION

a. EXAMINATION

i. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
ii. Proceed with installation only after unsatisfactory conditions have been corrected.

b. ROLLER SHADE INSTALLATION

i. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

ii. Roller Shade Locations: At exterior windows.

c. ADJUSTING

i. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

d. CLEANING AND PROTECTION

i. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
ii. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
iii. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

Section 123616
Custom Metal Countertops

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Custom stainless steel countertops.
2. Stainless steel backsplashes.
3. Stainless steel aprons and edge treatments.
4. Integral stainless steel sinks where indicated.
5. Countertop support brackets and accessories.

1.2 RELATED SECTIONS

A. Section 06 10 00 – Rough Carpentry.

B. Section 06 4 16 – Plastic Laminate Clad Architectural Cabinets

C. Section 22 40 00 – Plumbing Fixtures.

1.3 REFERENCES

A. ASTM A240/A240M – Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip.

B. ASTM A666 – Annealed or Cold-Worked Stainless Steel Sheet, Strip, Plate, and Flat Bar.

D. NAAMM Metal Finishes Manual.

1.4 SUBMITTALS

A. Product Data:

1. Stainless steel sheet material.
2. Countertop construction methods.
3. Support systems and accessories.

B. Shop Drawings:

1. Plans, elevations, sections, and details.
2. Joint locations.
3. Sink and fixture cutouts.
4. Anchorage and support requirements.

C. Samples:

1. Minimum 6-inch by 6-inch stainless steel sample indicating finish.
2. Corner detail sample.

1.5 QUALITY ASSURANCE

A. Fabricator shall have a minimum of five years documented experience manufacturing custom stainless steel countertops.

B. Welders shall be qualified in accordance with AWS standards applicable to stainless steel fabrication.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products wrapped and protected from scratching, staining, and distortion.

B. Store in a dry location and protect from construction damage.

1.7 WARRANTY

A. Provide manufacturer's standard one-year warranty against defects in materials and workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Elkay Manufacturing.
2. Advance Tabco.
3. Eagle Group.
4. Stainless Craft Corporation.
5. Or approved equal.

2.2 MATERIALS

A. Stainless Steel:

1. Type 304.
2. ASTM A240.
3. Minimum thickness:
    - Countertops: 16 gauge.
    - Backsplashes: 18 gauge.
4. Finish: No. 4 satin finish unless otherwise noted.

B. Reinforcement:

1. Moisture-resistant plywood substrate, minimum 3/4 inch thick.

2. Galvanized or stainless steel reinforcement members as required.

C. Fasteners:

1. Stainless steel, concealed where possible.
2. Compatible with adjacent materials.

2.3 FABRICATION

A. Fabricate countertops to dimensions indicated on drawings.

B. Form exposed edges with one-piece construction wherever practical.

C. Weld exposed seams continuously; grind smooth and polish to match adjacent finish.

D. Fabricate countertops free of warp, buckles, dents, and imperfections.

E. Backsplashes:

1. Height: 4 inches unless otherwise indicated.
2. Coved and fully welded at countertop junction.
3. Seal watertight.

F. Front Edge Profile:

1. Square marine edge.

G. Sink Openings:

1. Factory cut and reinforced.
2. Coordinate with plumbing fixture schedule.

2.4 ACCESSORIES

A. Support Brackets:

1. Heavy-duty stainless steel brackets.
2. Sized to support imposed loads without deflection.

B. Sealant:

1. NSF-approved silicone sealant.
2. Color: Clear.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify dimensions and conditions affecting installation.

B. Do not install until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install level, plumb, and securely anchored.

B. Scribe countertops to adjacent surfaces for tight fit.

C. Shim as required to provide continuous bearing.

D. Install backsplashes tight to wall surfaces.

E. Seal joints between countertops, backsplashes, sinks, and adjacent materials with silicone sealant.

3.3 FIELD QUALITY CONTROL

A. Verify completed installation is rigid, secure, and free from distortion.

B. Replace damaged components that cannot be restored to original condition.

3.4 CLEANING AND PROTECTION

A. Remove protective coverings after installation.

B. Clean surfaces with cleaners recommended for stainless steel.

C. Protect completed work from damage until Substantial Completion.

END OF SECTION 12 36 16

SECTION 123623.13
PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad countertop (refer to drawings for locations).

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: For plastic-laminate-clad countertops.

1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.
3. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: Plastic laminates in each type, color, pattern, and surface finish required in manufacturer's standard size.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project for at least 10 years and whose products have a record of successful in-service performance.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.5 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations with Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.

B. Grade: Premium .

C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS .

1. Basis-of-Design Product: Subject to compliance with requirements, provide -Wilsonart as scheduled or comparable product by one of the following:
   a. Formica Corporation.
   b. Pionite; a Panolam Industries International, Inc. brand.

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As selected by Architect from manufacturer's full range in the following categories:

   a. Refer to finish schedule for color selection.

E. Edge Treatment: **Post-Formed Bullnose Edge**

F. Core Material: As selected by fabricator to comply with quality standard.

G. Core Material at Sinks: exterior-grade plywood .

H. Core Thickness: 1-1/8 inch.

1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.

I. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.

2.3 MISCELLANEOUS MATERIALS

A. Adhesive for Bonding Plastic Laminate: As selected by fabricator to comply with requirements.

1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.4 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 1/2 inch over base cabinets. Ease edges to radius indicated for the following:

1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

D. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
2. Seal edges of cutouts by saturating with varnish.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten in accordance with manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical-treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

F. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches variation from a straight, level plane.
2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.

3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

B. Clean countertops on exposed and semiexposed surfaces.

C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 123623.13

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SECTION 123661.16
SOLID SURFACE SILLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Solid surface material window sills.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For Sills. Show materials, finishes, and edge profiles.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Initial Selection: For each type of material exposed to view.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

PART 2 - PRODUCTS

2.1 SOLID SURFACE MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on or comparable product by one of the following:
   a. Formica Corporation.
   b. Wilsonart LLC.
2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium .

B. Window Sills: 1/2-inch- thick, solid surface material with front edge built up to 1” with same material.

C. Fabricate with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

D. Joints: Fabricate without joints.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

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

3.2 INSTALLATION

A. Install level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Secure window sills to framing with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

D. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

E. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

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SECTION 126600

GYMNASIUM BLEACHERS

1. Part 1 General

1.1 Work: Harbor Beacher Middle School Bleacher Replacement

A. Telescoping gymnasium bleachers shown in architect's plans and specifications as manufactured by Interkal of Kalamazoo, MI.

1.2 Related Work

A. Electrical.

B. Gymnasium flooring.

C. Stamped Engineering Drawing by Bleacher Contractor for BFS and BCC Plan Review Submittals by Other.

1.3 References

A. Applicable building codes as listed on drawings.

1.4 Description of the System

A. The bleacher system shall be comprised of multiple tiered, closed deck seating rows operating in a telescopic manner, incorporating the most economical quantity of sections while still complying with all loading requirements.

B. The first moving row shall be secured with friction or mechanical locks. Other rows shall be mechanically locked, operable only upon unlocking and cycling the first row, quantity to be determined by Interkal engineering.

C. Each bleacher row shall be comprised of risers, seat and deck components, and a complete set of supportive columns and braces.

D. The telescopic bleacher shall incorporate a locking system permitting the use of one, several, or all rows, each locked in the extended position.

1.5 Quality Assurance

A. **Qualifications**

1. Manufacturing. Manufacturer shall be regularly engaged in the design and manufacturing of telescopic seating for not less than thirty years.

2. Engineering. It shall be mandatory that each bidder submit with their bid an affidavit signed by a Registered Professional Engineer stating that the product to

be supplied has been tested by an independent testing facility and meets all applicable code requirements.

B. **Deviations**

1. It shall be the responsibility of the bidder to furnish with their bid a list clarifying any and all deviations from these specifications, written or implied. Those bidders not submitting a list of deviations will be presumed to have bid as specified.

C. **Warranty**

1. 10 year warranty. The manufacturer shall warranty structural components of the understructure for a period of 10 years.

2. 5 year warranty. The manufacturer shall warranty all non-structural materials such as accessories, everything at deck level and above, and all power and electrical components for a period of 5 years.

D. **Product Improvements**

1. Seating provided shall incorporate manufacturer's design improvements and materials current at time of shipment.

1.6 Submittals

A. Submit manufacturer's installation instructions and descriptive literature in accordance with Section 013000.

B. Manufacturer's operating and maintenance manuals in accordance with Section 017000.

1.7 Design Criteria

A. Telescopic bleacher design and fabrication shall conform to NFPA 101 2012 and Ansi Accessibility requirements.

B. Telescopic gymnasium seating will be designed to support a vertical live load of 100 PSF, but not less than 120 PLF on both seat boards and footboards. Seating shall also be designed to carry a horizontal sway force of 24 PLF parallel to the seating and 10 PLF perpendicular to the seating.

C. Steel components shall be cold-formed from appropriate width strip stock conforming to ASTM A570 - Grade C 30KSI, ASTM A653- Grade 33 and 50, ASTM A500 - Grade B 46 KSI as applicable.

D. Lumber components are kiln dried, finger jointed, edge glued southern pine of grade "B & B Finish" manufactured to the current SPIB glued-laminated standards for southern pine.

E. Plywood deck boards shall be fabricated from Douglas Fir Premium Underlayment with exterior glue, 5 ply minimum, solid crossband directly under face ply, species Group 1 and manufactured in accordance with PS-1-95.

2. Part 2 Products

2.1 Manufacturer

A. Telescopic seating as manufactured by Interkal, Kalamazoo, Michigan, is the standard of quality required and specified herein.

2.2 Materials

A. **Model**

1. Interkal, closed deck telescopic bleacher.

B. **Type**

1. Wall Attached.

C. **Quantity**

1. Provide 1 bank of Wall Attached 9 rows high. 385 Net Seats.

D. **ADA**

1. **Notchouts**. Provide 3'-0 1/4" wide wheel chair spaces as shown on the plans and as required to meet local code jurisdiction compliance with ADA. Notchouts to be 1 row deep.

E. **Dimensions**

1. Rise per row. 10.25.

2. Row to row spacing. 24.

F. **Propulsion**

1. **Friction Power**. Furnish Interkal friction power, integral automatic electro-mechanical propulsion system to open and close telescopic seating system. Operation shall assure full visual control of the seating bank. The Wide Track System incorporates two friction drive roller assemblies as an integral part of both first row vertical column assemblies. Each section of bleacher shall have a power system that shall consist of two vertical column roller assemblies which shall include two 6" diameter by 2 ½" wide cast drive wheels for a minimum of four friction roller contact points per section of bleacher. Each roller shall have a specially formulated 45-durometer rubber covering to grip the floor as the units roll in and out. The two friction drive roller assemblies shall be installed a minimum of 7' apart per section. The two friction roller assemblies are linked together by a continuous drive shaft driven by a 1/2 H.P. 208 volt 3-phase motor

that shall enable the rollers to work simultaneously, resulting in a more efficient operation with allowance for minor variations in the floor surface. All floor friction power systems shall be controlled by a dual directional, removable walk along pendant which plugs into the front of the first row to give the operator proper position for visual control. The pendant control voltage shall be 24 VAC @ less than 50 mA for the safety of all operating personnel. **The entire power system shall be U.L. Recognized.** A 208 volt 3-phase power source, including conduit, wiring, and safety disconnect must be provided by others. The electrical contractor shall perform the connections to the seating equipment at the safety disconnect. Motors, housing, and wiring shall be installed by certified personnel.

2.3 Accessories

A. Foot Level Aisles

1. Provide footrest level aisles at locations and sizes as shown on plans and approved shop drawings.

2. Center Aisle. Provide a permanently attached self-storing aisle rail which is designed to eliminate all labor associated with set up and storage of the aisle rails.

3. Intermediate Steps. Provide manufacturers' standard intermediate step as necessary per applicable code.

B. Wheelchair Seating

1. Recoverable Notchouts. Provide manufacturers' standard recoverable handicap notchouts (3'-0 1/4" wide) located as shown on architectural drawings. Notchouts to be 1 row deep.

C. Self-Storing End Rails

1. Provide steel self-storing 42" high self-storing end guard rails with tubular supports and vertical intermediate members to comply with all code requirements. Rails shall be fitted to each exposed bank end from third row and above with all steel to steel connections. Finish shall be a polyester powder coat.

D. Vinyl End Curtains

1. Provide 2 of the manufacturers' standard vinyl end curtains to close off under the bleacher units in the extended position. Curtain color is to be from standard swatch.

2.4 Fabrication

A. Continuous Wheel Channel

1. Wheel channels shall consist of a one piece formed steel channel welded to the base of a vertical column. Wheel channels accommodate 8 to 12 wheels per row

for maximum weight distribution and operating ease. The number of wheels increases as the number of rows increase.

B. **Wheels**

1. 3-1/2" diameter with 1-1/8" non-marring soft rubber face with rounded edges designed to protect wood or synthetic floor. Provide 1/2" diameter axle for all wheels.

C. **Columns**

1. Electrically welded closed rectangular steel tube, 2" x 3" minimum size, 14-guage steel fitted with a rear welded gusset at the wheel channel.

D. **Row Interlocks**

1. Join each row structure front to rear by means of two (2) interacting steel connections, plus automatic gravity row locks where Engineering determines they are required.

2. Lower track guides shall be an external superslide rod to guarantee positive engagement of vertical supports without binding and assures smooth operation over uneven floor conditions.

3. Upper track guides shall completely interlock adjacent understructure support. A welded stop to ensure correct extension of bleacher unit on deck support. Use of bolt and nut stops is not acceptable, due to risk of loosening.

E. **Diagonal Braces**

1. Structural formed steel truss fitted to rows 4 and beyond. Bracing shall be attached to the rear riser at optimum locations to insure structural integrity. Bracing shall be designed and shaped to support a minimum load of 1000 lbs. of both compression and tension forces created when the bleacher is loaded.

F. **Deck Supports**

1. Shall be of structural steel, 11 gauge spaced not greater than 60" on center for maximum deck stiffness. Every deck support not attached to a vertical post shall have an integral nylon roller to avoid steel to steel friction points for more efficient operation.

G. **Decking**

1. All deck boards shall consist of 19/32" nominal C-C plugged Group 1 plywood with exterior glue and solid cross bands. Tongue and Groove deck boards are unacceptable. An extruded aluminum "H" connector shall be placed between plywood panels. Exposed wear surfaces shall be finished with a layer of high Density polyethylene plastic .025 - .030 thick, light gray in color, complimentary to the seat option. Deck finishes, such as clear coat, requiring more than simple touch up to restore it to a new appearance after wear occurs are unacceptable.

H. **Welds**

1. All welds shall be made at the factory by welders that are AWS certified on the equipment and process used.

I. **Nose Beam**

1. Shall be one-piece grade 40 galvanized steel. A minimum design thickness of .094" is utilized for the necessary structural integrity to accommodate section lengths up to 26'.

J. **Rear Riser**

1. Shall be one piece formed 14-gauge, grade 40 steel, with a continuous access joint to fully encapsulate footrest panel for ease of cleaning and additional structural support. 14-gauge roll formed steel is utilized for the necessary structural integrity to accommodate section lengths up to 26'.

K. **Splice Plates**

1. Each section joint shall be tied together with two structural steel members per row, employing a minimum of four steel to steel through bolt connections at the nose beam and a minimum of eight steel to steel through bolt connections at the lower steel rear riser. Splice plate material to match the nose beam and rear riser. Splice plates employing steel to plywood deck board attachments will not be acceptable. In order to minimize deflections and keep rows in alignment during operation, splice connections shall transfer both axial loads (tension/compression) and bending.

L. **Fasteners**

1. All structural connections shall be made with S.A.E. grade 5 or better stress rated bolts. The use of self-tapping bolts is not acceptable.

M. **Finish**

1. Steel Understructure abraded, cleaned and finished with russet brown water base acrylic paint. Steel risers and nose beams finished with corrosion resistant silver gray matte finish with galvanized alloy plating.

2.5 Seat Options

A. Excel Seat Modules

1. 18" wide one-piece individual seating modules shall be constructed of solid injection molded high-density polyethylene. Provide in 10" depth.

2. Each module shall have three longitudinal and five transverse internal ribs to provide additional structural integrity and resistance to impact.

3. Each module shall have a full 3/8" interlock to the adjacent module around the perimeter to eliminate pinching hazards and assure proper alignment.

4. Each module shall be equipped with an 11 gauge steel bracket for a steel-to-steel attachment of each module to the galvanized steel nose beam for maximum rigidity. All such mounting hardware shall be concealed.

5. Each module shall have a 2 ¼" x 1" recessed area for optional seat numbering.

6. End caps shall be provided at the ends of each bank (section, if manual) of seating as well as at each aisle.

7. Each end cap shall have two recessed areas including a 3 ½" x 3 ½" area for custom logos and a 2 ¼" x 1" area for optional row letters or numbers.

8. Select from manufacturer's 15 standard solid colors.

3. Part 3 Execution

3.1 Inspection

A. Verify that areas to receive telescopic bleachers are free from impediments interfering with installation.

B. Do not begin work until building conditions are satisfactory.

3.2 Installation

A. Install telescopic bleachers in accordance with manufacturer's instructions and approved submittal drawings.

B. Adjust bleachers for smooth and proper operation.

C. Clean bleachers and remove all debris from gymnasium resulting from installation.

Harbor Beach Middle School

QTY	DESCRIPTION	SEATS	RISE	SPAN
Bank #1	9 Row Friction Power Wall Attached 77'-0" W/ 10" Excel Seat Module -00 TBE	385	10.25	24
3	9 Row Foot Level Aisles W/ Self-Storing F-Rail			
3	9 Row Intermediate Steps			
6	1 Row Recoverable 3'-0 1/4" Notchout			
2	9 Row Self-Storing End Rails			
1	Vinyl End Curtains LH			
1	Vinyl End Curtains RH			

NOTES:

TOTAL SEATS 385

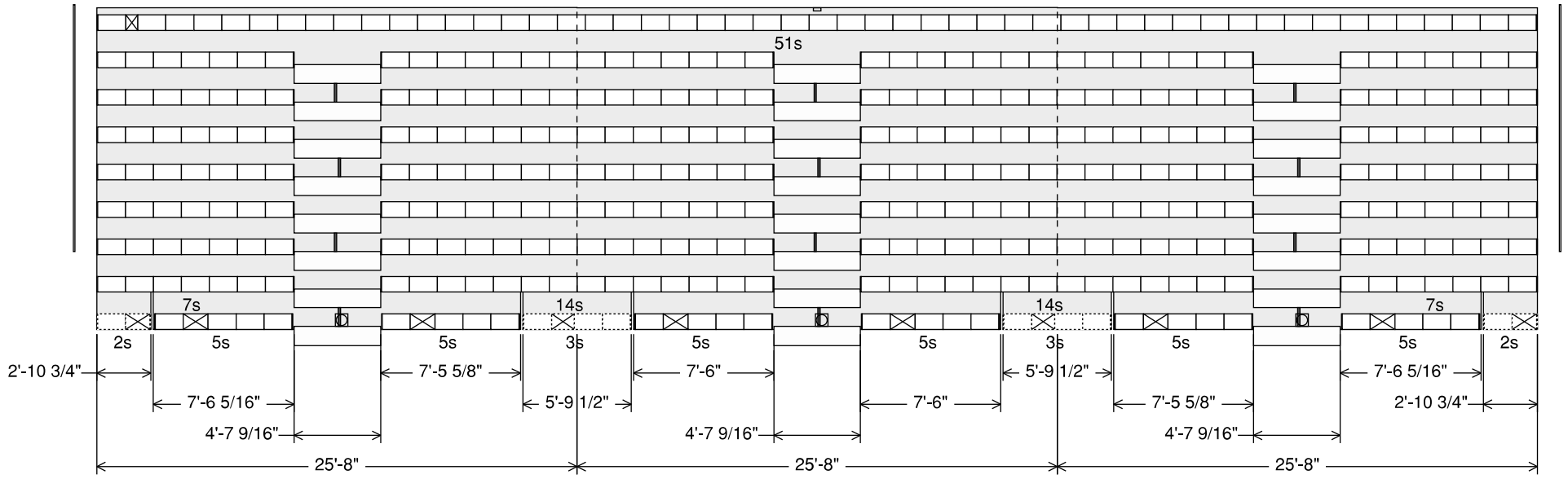
Interkal
Spectator Seating World Wide
www.interkal.com

5981 East Cork Street, PO Box 2107, Kalamazoo, MI 49003-2107
telephone (269) 349-1521 fax (269) 349-6530

POWER REQUIREMENTS:
1. Wiring and non-fusible safety switch(es) suitable for the line voltage to be provided by electrical contractor or others with branch circuit protection to each not exceeding 15 amps.
2. Branch circuit protection devices by others to be accessible when platforms are closed.
3. Verify electrical information:
   Circuit 3 Phase, 208-230 Volts, 60 Hertz.
   Each 1/2 Horse Power Motor Draws 2.0-2.2 amps. Full Load.
   Motors run simultaneously.
4. Junction box(es) by electrical contractor to be mounted at locations TBD, 5' AFF. Typical location shall be at section joints.

Harbor Beach Middle School

Bank 1 - 77'-0" Friction Power
Building Code: NFPA 101 2012
79'-6" Clear Dimension
9 Row - 24 Span - 10.25 Rise
385 seats (EM10)



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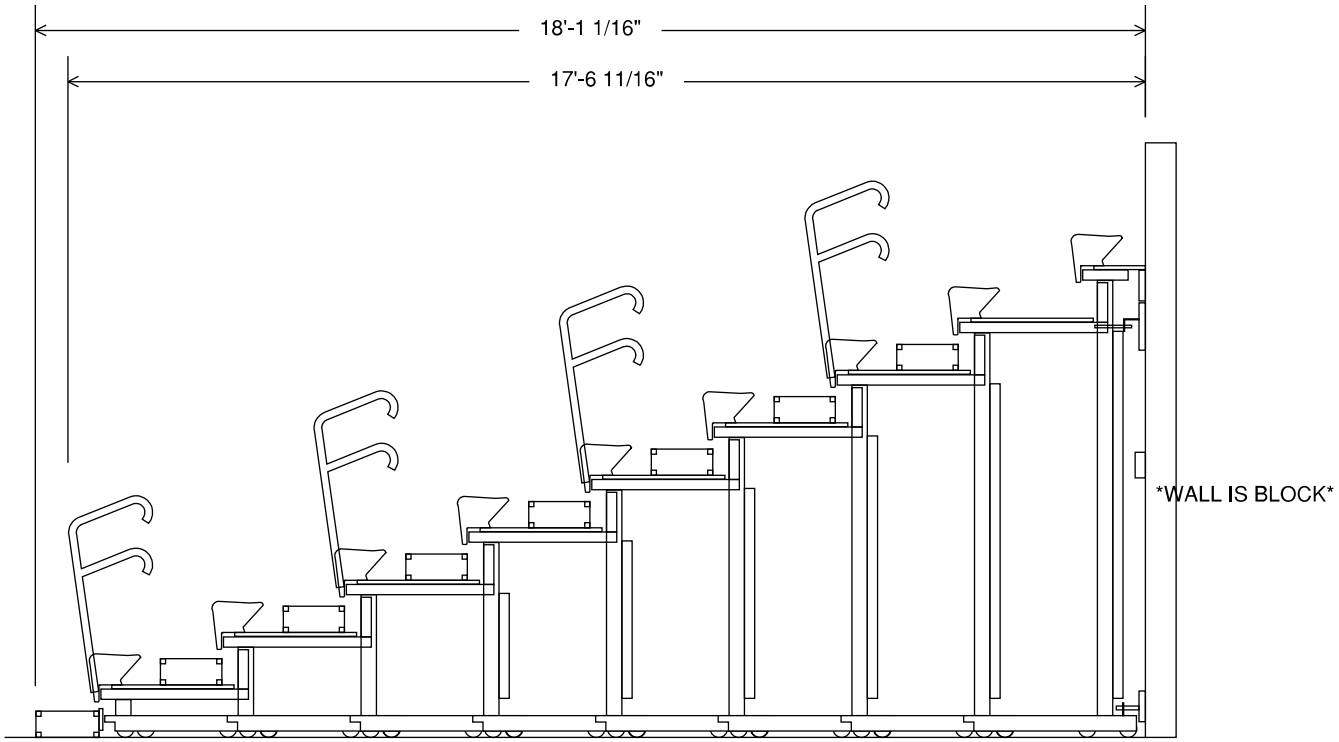
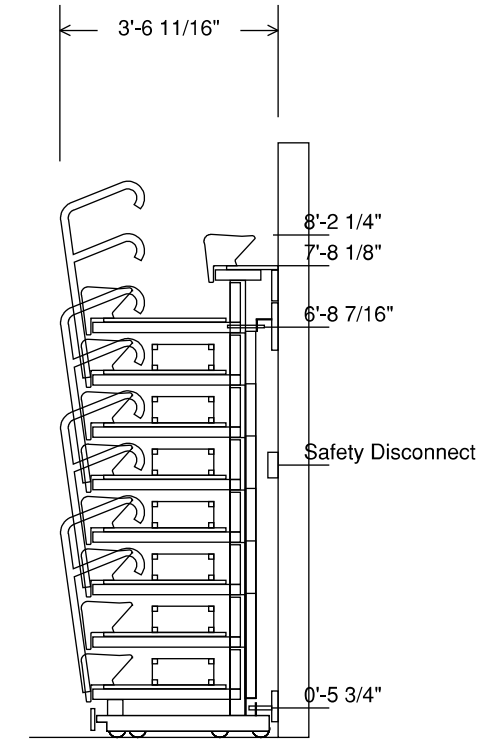
Plan View

Harbor Beach Middle School

Bank 1 - 77'-0" Friction Power
Building Code: NFPA 101 2012
9 Row - 24 Span - 10.25 Rise - Wall Attached
385 seats (EM10)



FLOOR IS WOOD FLOATING



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Side Elevation View

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.

B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

C. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.

B. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig minimum.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
4. Pressure Plates: Carbon steel.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.
b. Permathane®/Acryl-R®; ITW Polymers Sealants North America.
c. Polymeric Systems, Inc.
d. Sherwin-Williams Company (The).
e. The Dow Chemical Company.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.

D. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in slabs-on-grade at piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Use grout or silicone sealant, to seal the space around outside of sleeve-seal fittings.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system, or sleeve-seal fittings.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

END OF SECTION

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Sprinklers.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.

B. Design Data:

1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Field Test Reports:

1. 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."
2. Fire-hydrant flow test report.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

1.8 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of sprinkler service.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.

C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

D. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

1. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculation required in “Quality Assurance” article.

2. Sprinkler system design shall be approved by authorities having jurisdiction.

a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
b. Sprinkler Occupancy Hazard Classifications:

1) Building Service Areas: Ordinary Hazard, Group 1.
2) General Storage Areas: Ordinary Hazard, Group 1.
3) Office and Public Areas: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
c. Special Occupancy Hazard: As determined by authorities having jurisdiction.

4. Minimum Density for Deluge-Sprinkler Piping Design:

a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over entire area.
b. Special Occupancy Hazard: As determined by authorities having jurisdiction.

5. Maximum protection area per sprinkler according to UL listing.
6. Maximum Protection Area per Sprinkler:

a. Office Spaces: 225 sq. ft..
b. Storage Areas: 130 sq. ft.
c. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Black-Steel Pipe: ASTM A53/A53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Black-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.

C. Uncoated-Steel Couplings: ASTM A865/A865M, threaded.

D. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

2.3 CPVC TUBE AND FITTINGS

A. Extruded or molded CPVC: Pipe shall meet or exceed the requirements of ASTM F442 material designation CPVC 4120-06 in standard dimension ration (SDR) 13.5.

B. Pipe must be marked with the following pressure ratings: “320 PSI @ 73°F”, “175 PSI @ 150°F” and “100 PSI @ 180°F”.

C. Fittings shall meet or exceed the requirements of ASTM F437 (schedule 80 threaded), ASTM F438 (schedule 40 socket) or ASTM 439 (schedule 80 socket).

D. Pipe compound shall meet cell class 23547 and the fittings compound shall meet cell class 24447 as defined by ASTTM D1784.

E. Both pipe and fittings shall be listed by Underwrites Laboratories for use in automatic fire sprinkler systems and shall bear the logo of the listing agency. See UL Fire Protection Equipment Directory, categories VIWT and HFYH.

F. Both pipe and fittings shall be certified by NSF International for use with potable water.

G. Ancillary products (including, but not limited to fire stops, thread sealants, leak detectors, etc.) coming into contact with pipe and fittings must be chemically compatible with manufacturer's CPVC pipe and fittings.

H. Manufacturer: Subject to compliance with requirements, provide products by the following:

1. BlazeMaster.

2.4 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by oen of the following:

    a. Anvil International.
    b. Grinnell; a registered trademark of Tyco International Ltd.
    c. Shurjoint-Apollo Piping Products USA Inc.
    d. Victaulic Compant.

2. Standard: UL 213.
3. Pressure Rating: 175-psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.
9.

B. Adjustable Drop Nipples:

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

    a. Aegis Technologies, Inc.
    b. CECA, LLC.
    c. CPS Products, Inc.
    d. Merit Manufacturing.

2. Standard: UL 1474.
3. Pressure Rating: 250-psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

C. Flexible Sprinkler Hose Fittings:

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

    a. ALEUM USA.
    b. FlexHead Induistries, Inc.
    c. Gateway Tubing, Inc.
    d. Victaulic Company.

2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.5 SPRINKLERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc. (The).
3. Tyco by Johnson Controls Company.
4. Venus Fire Protection Ltd.
5. Victaulic Company.
6. Viking Corporation.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

D. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

E. Sprinkler Finishes: Chrome plated.

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: Chrome-plated steel, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

    a. Reliable Automatic Sprinkler Co., Inc. (The).
    b. Tyco by Johnson Controls Company.

c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

F. Fill sprinkler system piping with water.

G. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

H. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

I. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Install couplings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Ream ends of pipes and tubes and remove burrs.

D. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

E. 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.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

G. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.

3.4 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.5 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.8 PIPING SCHEDULE

A. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. CPVC extruded or molded pipe and solvent welded fittings.

3.9 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Corridors with Suspended Ceilings: Concealed sprinklers.
3. Toilet Rooms with Gypsum Ceilings: Concealed sprinklers.
4. All other areas with Suspended Ceilings: Pendant sprinklers.
5. Wall Mounting: Sidewall sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Upright and sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section covers basic materials and methods which may be common to two or more subsequent sections.

1.2 QUALITY ASSURANCE

A. Chemical and physical properties of all materials, design, performance characteristics and methods of construction of all items of equipment shall be in accordance with the following applicable regulations, references, and standards of current editions in effect 30 days prior to receipt of bids:

1. Factory Mutual Laboratories (FM).
2. National Electrical Manufacturer's Association (NEMA).
3. National Fire Protection Association (NFPA).
4. Plumbing and Drainage Institute (PDI).
5. Underwriters' Laboratories, Inc. (UL).
6. American National Standards Institute (ANSI).

B. All work, materials and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state and federal authorities. Such codes, where applicable, shall take precedence over these drawings and specifications.

C. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

D. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

1.3 MATERIALS AND MANUFACTURERS

A. Unless otherwise noted all materials and equipment shall be new, free of defects, installed in accordance with manufacturer's current published recommendations in a neat manner and in accordance with standard practice of the Industry.

B. Certain materials and/or equipment in this specification are specified by manufacturer and catalog numbers. The design was based on the specified equipment and establishes a degree of quality, performance, physical configuration, etc. If the Contractor should elect to use equipment other than the equipment used as a basis for design but listed as "acceptable" in the Specifications, Contractor shall be responsible for space requirements, configuration, performance and changes in other appurtenances that may be affected by itsuse.

C. Contractor further agrees that if deviations, discrepancies, or conflicts between reviewed submittals and shop drawings, and the Contract Documents in the form of design drawings and specifications are discovered after submittals and/or shop drawings are processed by the Architect/Engineer, the design drawings and specifications shall control and shall be followed at no additional cost to Owner or Engineer.

1.4 SUBSTITUTION APPROVALS

A. Equipment and/or materials manufactured by any one of the manufacturers listed in this specification or on the drawings shall be acceptable.

B. Where no specific manufacturer is listed, a first-class item of cataloged manufacturer shall be furnished.

C. Where specifications list a manufacturer and then state, 'or approved equal', it shall be the contractors' responsibility to obtain in writing the Engineers approval of the proposed 'equal' product prior to bids. Contractor shall not simply assume a product will be approved 'as equal' based on supplier representatives' verbal statements.

D. Coordinate with Division 1 for substitutions and forms tofollow.

1.5 QUIET OPERATION AND VIBRATION

A. All pumps, water heaters, and other equipment provided under this contract shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Architect/Engineer. Sound or vibration noticeable outside of its own room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Architect/Engineer shall be corrected in an approved manner by the Contractor at his expense. Vibration control shall be by means of approved vibration eliminators in a manner as recommended by the manufacturer of the eliminators.

1.6 PERMITS AND INSPECTIONS\

A. Plumbing contractor shall file for, pay all fees, and obtain all applicable plumbing and other permits required to receive approvals for occupancy and use of the premises.

B. Contractor shall call for, and ascertain all inspections are completed and approvals obtained for the work prior to submitting an application for finalpayment.

PART 2 - PRODUCTS

2.1 VALVES

A. All valves, except as otherwise specified in detail specifications, shall be of one manufacturer: Victaulic, Jomar, Apollo, Milwaukee Valve, Crane, Kennedy, Jenkins, Hammond, Powell, Nibco (gate valves - block pattern) and are to be manufactured in accordance with the Manufacturer's Standardization Society of the Valves and Fittings Industry Standards wherever applicable.

B. Ball valves shall be used in lieu of gate valves wherever the pressure and temperature ratings of same are satisfactory for the intended service and valve can be operated easily from floor or platform.

C. Listed manufacturer's numbers in detailed specifications are for cross reference purposes

D. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.1 for power piping valves.
7. ASME B31.9 for building services piping valves.

E. Ball Valves:

1. NPS 2 and Smaller:

a. Brass, Two-Piece (Dezincification Resistant Brass Alloy, Lead-Free):

1. Standard: MSS SP-110 or MSS SP-145.
2. CWP Rating: 600 psig, non-shock.
3. Body Design: Two piece.
4. Body material: Forged brass.
5. Ends: Threaded or solder.
6. Seats: PTFE.
7. Stem: Brass, blow-out proof.
8. Ball: T.E.A. (ternary eco alloy) coated brass.
9. Port: Full.

2. NPS 2-1/2 and Larger:

a. Steel, Class 150:

1. Standard: MSS SP-72.
2. CWP Rating: 285 psig, non-shock.
3. Body Design: Split body.
4. Body material: Carbon steel, ASTM A216, Type WCB.
5. Ends: Flanged or threaded.
6. Seats: PTFE.
7. Stem: Stainless steel, blow-out proof.
8. Ball: Stainless steel, vented.
9. Port: Full.

b. Iron, Class 125:

1. Standard: MSS SP-72.
2. CWP Rating: 200 psig, non-shock.
3. Body Design: Split body.
4. Body material: ASTM A126, gray iron.
5. Ends: Flanged or threaded.
6. Seats: PTFE.
7. Stem: Stainless steel, blow-out proof.
8. Ball: Stainless steel.
9. Port: Full.

F. Recirculation System Balancing Valves:

1. One-piece non-ferrous brass/bronze flow measuring and balancing/shut-off valve combination rated to 150 psig. Flow element shall be a low loss/high signal Venturi or orifice meter equipped with pressure and temperature test ports and caps. Valve shall be ball type with teflon seats and blow-out proof stem with teflon packing. Valves shall provide positive shut-off, memory stop, and union, equal to Circuit Setter by B & G.

G. Swing Check Valves:

1. NPS 2 and Smaller:

a. Bronze with Bronze Disc, Class 125:

1. Standard: MSS SP-80, Type 3.
2. CWP Rating: 200 psig.
3. Body Design: Horizontal flow.
4. Body Material: ASTM B62, bronze.
5. Ends: Threaded or solder.

2. NPS 2-1/2 and Larger:

a. Iron with Metal Seat, Class 125:

1. Standard: MSS SP-71, Type 1.
2. CWP Rating: 200 psig, non-shock.
3. Body Design: Clear or full waterway.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Bronze.
7. Gasket: Asbestos free.

b. Iron with Metal Seat, Grooved-End:

1. CWP Rating: 300 psig, non-shock.
2. Body material: ASTM A536, ductile iron.
3. Seal: EPDM.
4. Disc: Spring-operated, ductile iron or stainless steel.
5. Can be installed vertically (flow upwards only) or horizontally.
6. Victaulic series 716.

c. Iron, Dual-Plate with Metal Seat, Class 125, Grooved-End:

1. Standard: API 594.
2. CWP Rating: 200 psig, non-shock.
3. Body Design: Wafer, spring-loaded plates.
4. Body Material: ASTM A126, gray iron.
5. Seat: Bronze
6. Victaulic series W715.

d. Iron, with Lever- and Spring-Closure Control, Class 125:

1. Standard: MSS SP-71, Type 1.
2. CWP Rating: 200 psig, non-shock.
3. Body Design: Clear or full waterway.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Bronze:
7. Gasket: Asbestos free.
8. Closure control: Factory-installed, exterior lever and spring.

e. Iron, Compact-Wafer, Center-Guided with Metal Seat, Class 125:

1. Standard: MSS SP-125.
2. CWP Rating: 200 psig, non-shock.

3. Body Material: ASTM A126, gray iron.
4. Ends: Flanged.
5. Style: Compact wafer.
6. Seat: Bronze:

3. Class 150 valves meeting the above specifications may be used where system pressure requires.
4. Alternative check valves (2½" and larger) shall be class 125/250 iron body, bronze mounted, wafer check valve, with ends designed for flanged type connection, aluminum bronze disc, EPDM seats, 316 stainless steel torsion spring, and hinge pin.
5. A spring-actuated check valve is to be used on pump discharge. Swing check with outside lever and spring (not center guided) is to be used on sewage ejectors or storm-water sump pumps.

H. Valves in insulated piping shall include a 2-inch stem extension, extended operating handle of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation, and memory stops that are fully adjustable after insulation is applied.

2.2 HANGERS AND SUPPORTS

A. Pipe hangers shall be manufactured of the same material as the pipe or be non-corrosive to the piping system to which it serves.

B. Multiple pipe runs may be supported on trapeze hangers. Trapeze shall be Unistrut P-100. Hanger rods shall be one size larger than size specified herein for largest pipe on trapeze. Where trapeze lengths exceeds 42", additional hanger rod shall be installed at midspan.

C. Except where governed by local codes, maximum hanger spacing and minimum hanger rod sizes shall conform to the following table:

	Pipe Size	Spacing	Hanger Rod
Steel Pipe	1/2"	6'-0"	3/8"
	3/4" thru 1-1/4 1-	8'-0"	3/8"
	1/2", 2"	10'-0"	3/8"
	2-1/2"	10'-0"	1/2"
	3"	12'-0"	1/2"
	4"	14'-0"	5/8"
	6"-8"	16'-0"	5/8"
Copper Pipe	1/2"	6'-0"	3/8"
	3/4" thru 1"	8'-0"	3/8"
	1-1/4" thru 2" 2-	10'-0"	3/8"
	1/2"	10'-0"	1/2"
	3"-4"	12'-0"	1/2"
Plastic Pipe	1-1/4", 1-1/2"	4'-0"	3/8"
(PVC)	2"	5'-0"	3/8"
	2-1/2", 3"	6'-0"	3/8"
	4", 6"	7'-0"	1/2"
	8"	8'-0"	5/8"
	10", 12"	8'-0"	3/4"
	14", 16"	8'-0"	1"

D. Vertical risers shall be supported at each floor line with steel riser clamps equal to Figure 230 as

manufactured by "Auto-Grip" Division, Automatic Sprinkler Corporation of America or equal of Michigan Hanger Company.

E. Insulated pipe where specified to be continuous through hanger shall be protected at points of support with thermal hanger shields as manufactured by Pipe Shields, Inc. or equal of Insulshield or Uni-Grip. Thermal hanger shields shall consist of a 360 insert of high density, 100 psi, water- proofed calcium silicate, encased in a 360 sheet metal shield. Insert to be same thickness as adjoining pipe insulation. Shield length and minimum sheet metal gauges shown in chart below:

Pipe Size	Shield Length	Minimum Gauge
1/2" - 1-1/2"	4"	26
2"-8"	6"	20

F. Floor type pipe supports for flanged piping, backflow devices, water meters, etc. shall be equal to Material Resources, "Standon" adjustable steel pipe support Model 89 for up to 12", Class 125 flanges.

G. Victaulic pipe hangers and supports shall be spaced in accordance with the following pipe spacing table to allow for the proper installation of the insulating materials on the pipe and fittings.

VICTAULIC PIPE SPACING

Pipe Size	Spacing on Pipe Centers 2 ½
	11 inches
3	11 inches
4	12 inches
5	14 inches
6	14 inches
7	15 inches
8	15 inches
10	15 inches

2.3 THERMOMETERS

A. Approved manufacturers are Duro Instrument Corp., Miljoco, H.O. Trerice Co.

B. Thermometers shall have die cast aluminum case with baked enamel finish; red reading tube with suitable 9" scale; adjustable multi-angle housing, brass separable socket.

2.4 PRESSURE GAUGES

A. Approved manufacturers are Duro Instrument Corp., Miljoco, H.O. Trerice Co., Ametek U.S. Gauge Division.

B. Pressure gauges shall have phenolic turret case; 4-1/2" dial with suitable range; phosphorous bronze Bourdon tube; corrosion-resistant movement; adjustable stainless steel pointer; 1% of full scale accuracy; 1/4" NPT brass connection.

C. Furnish the following with each pressure gauge: 1/4" brass needle valve Hammond IB415; pressure snubber (Ray Model 1).

2.5 ACCESS DOORS

A. Mechanical Contractor shall provide and locate all required access doors where they may be required to service equipment, valves, dampers, etc. in inaccessible ceiling and walls. General Contractor shall install.

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE OF MATERIALS

A. Make provisions for the delivery and safe storage of materials and make the required arrangements with other contractors for the introduction into the building of equipment too large to pass through finished openings.

3.2 PIPE AND FITTINGS

A. Piping is to be installed as shown on the drawings insofar as practical. When a pipe size is not indicated the subcontractor shall request the pipe size from the Architect/Engineer through the general contractor.

B. Provide sufficient swing joints, anchors, expansion loops, and/or devices necessary and install so as to permit free expansion and contraction without causing undue stresses. Make all changes in direction with fittings. Support piping independently at all equipment so that its weight shall not be supported by the equipment.

C. For water systems, Victaulic flexible couplings may be used on header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops (as approved by the engineer). Where loops are required, use flexible-type couplings on the loops.

D. Install piping without springing or forcing and clear all windows, doors, and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted.

E. All pipe shall be reamed to full pipe diameter before joining.

F. Install vertical risers plumb and straight, horizontal lines parallel with walls and partitions.

G. Provide shut-off valves and unions suitably located to isolate each item of equipment, branch circuit or section of piping.

H. Unions and flanges for servicing and disconnect are not required in installations using grooved joint couplings. (The couplings shall serve as disconnectpoints.)

I. Provide 1/2" drain valves at all low points of each system to enable complete drainage.

J. Provide dielectric unions or waterway fittings at all junctions of dissimilar metals in fresh water systems.

K. Grooved joint shall be installed in accordance with the manufacturer's written recommendations. Grooved ends shall be clean and free from indentations, projections, or roll marks. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service. The coupling manufacturer's factory trained representative shall provide on-site

training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor's representative is not considered qualified to conduct the training.)

L. All piping shall be adequately supported from the buildings structural framing system with adjustable hangers to maintain grading where required and to prevent sagging and pocketing.

M. Provide supports between piping and building structure where necessary to prevent swaying.

N. The use of wire or perforated metal to support pipe will not be permitted.

O. Do not install back-to-back change of direction or offset fittings such as ells and tees without a minimum of 3" nipple for the purposes of insulating the pipe properly.

3.3 CLEARANCE TO ELECTRICAL PANELS

A. In no case shall an exposed metallic pipe conveying any water or gas be located closer than 36" from the front or sides of an Motor Control Center (MCC), electrical breaker/fuse panel or transformer per NEC codes. When a pipe appears to be shown on the plans in close proximity to an electrical breaker panel or transformer, adjust the routing and position of that pipe or piping accordingly.

B. If the contractor deems that an extra is required to make the necessary offsets in a pipe for whatever reason, contact the engineer before installing the piping within 36". Any cost to relocate a pipe once installed to close to an electrical panel will be the responsibility of the contractor.

C. For MCC panels in excess of 800 amps, additional clearance requirements of 72" should be maintained.

3.4 OPERATION INSTRUCTIONS

A. Upon completion of all work and all tests, Contractor shall furnish the necessary skilled labor for operating all systems and equipment installed under this Division. The purpose is to demonstrate the workability of all systems and to instruct the Owner or his representative fully in the operations, adjustment, and maintenance of all equipment furnished utilizing the appropriate sections of the maintenance manual as a reference guide. Give at least 48 hours notice to the Owner and Architect/Engineer in advance of this period.

3.5 MAINTENANCE

A. The Contractor shall provide the necessary skills and labor to assure the proper operation and to provide all required maintenance for all equipment and controls provided under Division 22 for a period of one year after substantial completion of the contract as defined in paragraphs B through D below.

B. The Contractor shall receive calls for any and all problems experienced in the operation of the equipment provided under Division 22 and shall take steps to immediately correct any deficiencies that may exist.

C. All equipment that requires repairing shall be immediately serviced and repaired. Since the period of maintenance runs for one year concurrently with the warranty and guarantee, all parts and labor

shall be furnished at no extra cost to Owner (including all controls).

D. When emergency service is required beyond working hours to maintain the system in operation, the Contractor shall furnish such service.

3.6 SCAFFOLDING, RIGGING, HOISTING

A. Provide all scaffolding, rigging, hoisting, and services necessary for delivery, erection, and placement within the premises of any equipment and apparatus furnished. Remove same from premises when no longer required.

3.7 THERMAL CONTINUITY

A. Where openings are created for piping, vents, or any type of plumbing equipment penetration thru an insulated wall, roof, or partition, Plumbing Contractor shall be responsible for providing an air tight seal against air infiltration.

B. Where openings surrounding the item penetration the thermal barrier are larger than ¼", Plumbing Contractor shall fill opening with an insulation matching the existing R-value of the thermal barrier, but no less than R-18 for walls and R-30 for roofs, and then seal air tight.

3.8 WATERPROOFING

A. Where any work pierces waterproofing, the method of installation shall be as approved by the Architect/Engineer before work is done. Contractor shall furnish all necessary sleeves, caulking, and flashing required to make openings watertight.

3.9 ESCUTCHEON PLATES

A. Escutcheon plates shall be provided for all exposed uninsulated pipes passing through walls, floors, ceilings, into cabinets, or other areas where visually seen by occupants of the facility. Plates shall be nickel plated metal, of the split ring type, of size to match the pipe or conduit. Where plates are provided for pipes passing through sleeves which extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.

B. Plates for water supply penetrations serving sinks or water closets shall be one-piece non-split ring.

3.10 REMOVAL AND RELOCATION OF EXISTING PIPING AND/OR EQUIPMENT

A. The layout of the existing plumbing system as shown on the drawings has been prepared from inspection of the site. All data shown is the most accurate that is available at this time. Contractor shall visit the site to determine the exact quantities and the extent of equipment and piping to be removed and/or relocated prior to bid.

B. All materials to be removed shall become the property of the Contractor and shall be removed from the site unless specifically otherwise indicated on the drawings and/or tagged by Owner.

3.11 INSTALLATION

A. Unless otherwise specifically indicated on the plans or specifications, all equipment and materials shall be installed in accordance with the recommendations of the manufacturer. Maintain maximum headroom and space conditions at all points.

3.12 ACCESSIBILITY

A. Locate all equipment which must be serviced, operated, or maintained in fully accessible positions. If required for better accessibility, locate access doors for this purpose. Minor deviations from drawings may be made to allow for better accessibility.

3.13 CLEAN-UP

A. At the completion of work, all equipment on the project shall be checked and thoroughly cleaned. Clean all exposed surfaces of all piping, hangers, and other exposed metal of all grease, plaster, or other foreign material. Remove all stick-on labels and clean surfaces.

B. At the completion of each work day, remove from the building, the premises, and surrounding streets, alleys, etc., all rubbish and debris resulting from the operations and leave all equipment spaces absolutely clean and ready for use.

3.14 OLD PIPE LINES

A. Old sewer, water, or other pipes that exist shall be removed.

3.15 COORDINATION AND COOPERATION WITH OTHER TRADES

A. The Contractor for this work shall examine the drawings and specifications for other parts of the work, and if head room or space conditions appear inadequate, or if any discrepancies occur between the plans and his work and the plans for the work of others, he shall report such discrepancies to the Architect/Engineer and shall obtain written instructions for any changes necessary to accommodate his 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.

3.16 RECORD OF CHANGES

A. Show prints in red ink all changes from original plans made during installation of work and file with Architect/Engineer when work is complete.

B. Coordinate with Division 1 and portions of this section for "As-Built" drawings and specification requirements.

3.17 SURVEY AND MEASUREMENTS

A. Base all measurements, both horizontal and vertical, on established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.

B. If any discrepancy between actual measurements and those indicated is discovered, which prevents following good practice or the intent of the drawings and specifications, the Architect shall be notified through the general Contractor, and work shall not proceed until instructions are received from the Architect.

3.18 PROTECTION

A. The Contractor shall protect all work and material from damage by his work or workmen, and shall be liable for all damage thus caused.

B. The Contractor shall be responsible for work and equipment until finally inspected, tested, and accepted; protecting work against theft, injury, or damage; and shall carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.19 RESPONSIBILITY OF CONTRACTOR

A. The Contractor is responsible for the complete and satisfactory installation of the work in accordance with the intent of the drawings and specifications. He shall provide, without extra charge, all incidental items required, as part of his work, even though not particularly specified or indicated. The installation shall be so made that its several component parts will function together as a workable system and shall be left with all parts adjusted and in working order.

3.20 PENETRATION OF FIRE AND SMOKE BARRIERS

A. Penetrations of floor, wall and/or ceiling assemblies required to have a fire or smoke resistance rating shall be protected in accordance with all applicable codes and as further described in Division 22 specification sections.

B. Fire stop insulation for all copper, iron and steel pipe/duct where passing through fire walls shall

be ceramic fiber blanket equal to Manville "Cerablanket" 6 lb. density.

C. Fire stop insulation on plastic pipe penetrations through fire walls shall be an intumescent type wrap. Provide sleeves of adequate diameter to apply the required number of insulation wraps on pipe per manufacturer's requirement.

3.21 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare one hard bound copy and complete electronically scanned copy of an operation and maintenance manual which shall cover all plumbing fixtures and devices, pumps, water heaters and other systems installed under Division 22.

B. The manual shall be submitted to the Engineer in draft form for approval prior to preparation of three copies for final submission to the Architect for delivery to the Owner.

C. The manual shall be 8-1/2" x 11" size and assembled in loose-leaf three ring or post binders. The manual shall be adequately indexed and contain the following information.

1. Contractors' names, addresses, and telephone numbers
2. Alphabetical list of all system components with the names and addresses, and 24-hour phone number of the companies responsible for servicing each item during the warranty period.
3. Guarantees and warranties of all equipment whenever applicable.
4. All manufacturer's data that are applicable to the installed equipment such as the following:

    a. Shop drawings.
    b. Installation instructions.
    c. Lubrication instructions.
    d. Wiring diagrams.

5. All equipment shall be clearly identified as to the model, size, flow data, electrical characteristics, and other design and sizing parameters as may be applicable to the actual installed piece of equipment or systems described.
6. A simplified description of the operation of all systems including the function of each system, and piece of equipment within a system.
7. An outline of a preventative maintenance program for each system or item of equipment, and shall include a schedule of inspection and maintenance. It shall suggest the maintenance and inspection that should be performed by the owner and that which should be completed with outside service.

3.22 PATCHING AND REPAIR OF EXISTING OPENINGS

A. The plumbing contractor shall include within their bid unless specifically noted in the plans or specifications for another trade to complete the work, the material and labor for all infilling, patching and repair of existing openings through walls, floors or roofs that remain when plumbing systems such as pipe or other equipment are removed.

B. Unless specifically noted on the plans, the repair shall be of same material and color as the original surface being repaired. In the event the material being patched is not available or cannot be matched, consult the architect for a suitable material that can be used.

C. Employee or sub-contractor the work of infilling, patching, and repairing to a professional trade person skilled in the use of materials being used for the repair.

D. Include all painting or finishing of the surface to match existing color and texture.

E. Include the installation and repair of all trim, base molding, flooring, and other surface treatments when the mechanical work requires to provide a finished look to match all surrounding materials and surfaces.

3.23 PAINTING EXTERIOR FERROUS PIPING

A. All exterior ferrous piping shall be primed and painted.

B. Contractor shall grind the pipe smooth.

C. Clean piping and make ready for paint.

D. Prime all exterior piping with metal primer.

E. Paint with two coats of industrial enamel.

END OF SECTION

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Craftmark Pipe Markers.
d. Emedco.
e. Kolbi Pipe Marker Co.
f. LEM Products Inc.
g. Seton Identification Products; a Brady Corporation company.

1. Material and Thickness: Brass, 0.032-inch; stainless steel, 0.025-inch; or aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Letter Color: White.
3. Background Color: Black.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Brimar Industries, Inc.
    c. Craftmark Pipe Markers.
    d. Emedco.
    e. Kolbi Pipe Marker Co.
    f. LEM Products Inc.
    g. Seton Identification Products; a Brady Corporation company.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number. Owner may have an existing numbering scheme they would like to use.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.

3. Craftmark Pipe Markers.
4. Emedco.
5. LEM Products Inc.
6. Natinal Marker Company.
7. Seton Identification Products; a Brady Corporation company.
8. Stranco, Inc.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

C. Letter Color: Black.

D. Background Color: Yellow.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Actioncraft Products, Inc; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Brimar Industries, Inc.
4. Craftmark Pipe Markers.
5. Emedco.
6. Kolbi Pipe Marker Co.
7. LEM Products Inc.
8. Seton Identification Products; a Brady Corporation company.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Actioncraft Products, Inc; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Brimar Industries, Inc.
4. Craftmark Pipe Markers.
5. Emedco.
6. Kolbi Pipe Marker Co.
7. LEM Products Inc.
8. Seton Identification Products; a Brady Corporation company.

B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch; stainless steel, 0.025-inch; aluminum, 0.032-inch; or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain, beaded chain, or S-hook.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Craftmark Pipe Markers.
4. Emedco.
5. Kolbi Pipe Marker Co.
6. LEM Products Inc.
7. Seton Identification Products; a Brady Corporation company.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire or reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:

1. Low-Pressure Compressed Air Piping:

    a. Background: Blue.
    b. Letter Colors: White.

2. Domestic Cold Water Piping:

    a. Background: Green.
    b. Letter Colors: White.

3. Domestic Hot Water Piping:

    a. Background: Yellow.
    b. Letter Colors: Black.

4. Sanitary Waste and Storm Drainage Piping:

    a. Background Color: Green.
    b. Letter Color: White.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

    a. Cold Water: 1-1/2 inches, round.
    b. Hot Water: 1-1/2 inches, round.
    c. Low-Pressure Compressed Air: 1-1/2 inches, round.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Roof drains and rainwater leaders.
5. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220500 "Common Work Results for Plumbing."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General" and "Indoor Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA.
b. Armacell LLC.
c. K-Flex USA.

E. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Manson Insulation Inc.
d. Owens Corning.

2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ-SSL.
3. 850 deg F.
4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ramco Insulation, Inc.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ramco Insulation, Inc.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ramco Insulation, Inc.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

2.4 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

2.5 LAGGING ADHESIVES

A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

2.6 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane, consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Owens Corning.
    b. Polyguard Products, Inc.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M Industrial Adhesives and Tapes Division.
    b. Avery Dennison Corporation, Specialty Tapes Division.
    c. Ideal Tape Co., Inc., an American Biltrite Company.
    d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M Industrial Adhesives and Tapes Division.
    b. Avery Dennison Corporation, Specialty Tapes Division.
    c. Ideal Tape Co., Inc., an American Biltrite Company.
    d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.

5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M Industrial Adhesives and Tapes Division.
    b. Ideal Tape Co., Inc., an American Biltrite Company.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M Industrial Adhesives and Tapes Division.
    b. Avery Dennison Corporation, Specialty Tapes Division.
    c. Ideal Tape Co., Inc., an American Biltrite Company.
    d. Knauf Insulation.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. RPR Products, Inc.

2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy; 0.062-inch soft-annealed, stainless steel; or 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. C&F Wire.
    b. Johns Manville; a Berkshire Hathaway company.
    c. RPR Products, Inc.

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Buckaroos, Inc.
    b. Just Manufacturing.
    c. McGuire Manufacturing.
    d. MVG Molded Products.
    e. Plumberex Specialty Products, Inc.
    f. Truebro.
    g. Zurn Industries, LLC.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Truebro.
    b. Zurn Industries, LLC.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using **preformed** fitting insulation or mitered fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves by removing field-applied jacket and insulation in layers in reverse order of their installation.

C. All insulation applications will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:

    a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be the following:

    a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. Flexible Elastomeric: 1 inch thick.
    b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. Flexible Elastomeric: 1 inch thick.
    b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. See “Protective Shielding Pipe Cover” Article above.

3.11 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. PEX tube and fittings.
3. PP-R pipe and fittings.
4. Piping joining materials.
5. Transition fittings.
6. Dielectric fittings.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Pipe and tube.
2. Fittings.
3. Joining materials.
4. Transition fittings.

1.4 WARRANTY

A. Polypropylene Piping (PP-R) Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.

1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.
2. Warranty is to be in effect only upon submission by the Contractor to the manufacturer of valid pressure/leak documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B88, Type L.

B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.

C. Wrought Copper Unions: ASME B16.22.

D. Copper Tube, Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    b. Conex Banninger – USA.
    c. Elkhart Products Corporation.
    d. Mueller Industries, Inc.
    e. NIBCO INC.
    f. Viega LLC.

2. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end.
3. Minimum 200-psig working-pressure rating at 250 deg F.

2.3 PEX TUBE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Apollo Valves; a part of Aalberts Integrated Piping Systems.
2. IPEX USA LLC.
3. MrPex Systems Inc.
4. REHAU.
5. SharkBite, A Division of Reliance Worldwide Corporation.
6. Sioux Chief Manufacturing Company, Inc.
7. Uponor.
8. Viega LLC.
9. Zurn Industries, LLC.

B. Tube Material: PEX plastic according to ASTM F876 and ASTM F877.

C. Fittings: ASTM F1960, cold expansion fittings and reinforcing rings.

2.4 POLYPROPYLENE (PP-R) PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aquatechnik North America.
2. Aquatherm.
3. GF Piping Systems (Georg Fischer).
4. IPEX USA LLC.
5. NIBCO.

B. Polypropylene Pipe: ASTM F2389, pipe pressure rating to comply with temperature and pressure ratings of code requirements for the applicable service.

1. Polypropylene Fittings: ASTM F2389, socket fusion, butt fusion, electrofusion, or fusion outlet fittings to be used for fusion-welded joints between pipe and fittings.
2. Mechanical fittings and transition fittings to be used where transitions are made to other piping materials or to valves and appurtenances.
3. Polypropylene pipe is to be unthreaded. Threaded transition fittings per ASTM F2389 to be used where a threaded connection is required.

C. Smoke and Fire Ratings:

1. Where indicated on the Drawings that a plenum-rated piping system is required, the pipe is to be wrapped and/or insulated with fiberglass or mineral wool pipe insulation, and field installed.
2. The system is to have a flame spread classification of less than 25 and smoke development rating of less than 50.
3. Pipe, wrap, or insulation as a system to meet the requirements of CAN/ULC-S102.2-03, ASTM E84, or UL 2846.
4. For insulation required for thermal and condensation reasons, see Section 220719 "Plumbing Piping Insulation."

D. Integration of PP-R Piping Systems with Other Systems:

1. When integrating PP-R piping systems with other systems or with components not made of PP-R (for example, valves, pumps, other piping, check valves, or strainers), ensure the operating parameters for PP-R will not damage other materials in the system or vice versa.
2. Verify that all parts of the system are compatible with the medium being carried before installation. PP-R pipe does not require treatment to protect it from corrosion. Metals (ferrous and non-ferrous) in the system may be susceptible to corrosion. Provide water treatment to protect system metals.
3. Do not mix PP-R pipe with other piping systems in conditions that will cause the other system or components to fail.

E. PP-R Socket Fittings: ASTM F2389.

2.5 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B32, lead-free alloys.

B. Flux: ASTM B813, water flushable.

2.6 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cascade Waterworks Mfg. Co.
b. Dresser, Inc.
c. Ford Meter Box Company, Inc. (The)
d. Jay R. Smith Mfg Co; a division of Morris Group International.
e. JCM Industries, Inc.
f. Romac Industries, Inc.
g. Smith-Blair, Inc.
h. Viking Johnson.

D. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aquatherm.
b. Charlotte Pipe and Foundry Company.
c. Harvel Plastics, Inc.
d. Sioux Chief Manufacturing Company, Inc.
e. Spears Manufacturing Company.
f. Uponor.

2. Description:

a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aquatherm.
b. Colonial Engineering, Inc.
c. NIBCO INC.
d. Spears Manufacturing Company.

2. Description:

a. CPVC or PVC four-part union.
b. Brass or stainless steel threaded end.
c. Solvent-cement-joint or threaded plastic end.
d. Rubber O-ring.
e. Union nut.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A.Y. McDonald Mfg. Co.
b. Capitol Manufacturing Company.
c. Central Plastics Company.
d. HART Industrial Unions, LLC.
e. Jomar Valve.
f. Matco-Norca.
g. WATTS.
h. Wilkins.
i. Zurn Industries, LLC.

2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A.Y. McDonald Mfg. Co.
b. Capitol Manufacturing Company.
c. Central Plastics Company.
d. HART Industrial Unions, LLC.
e. Jomar Valve.
f. Matco-Norca.
g. WATTS.
h. Wilkins.
i. Zurn Industries, LLC.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

C. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Drawn-temper copper tube, ASTM B88, Type L.
2. PEX tube, ASTM F876.
3. Polypropylene (PP-R), SDR 7.4 pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.
4. Piping shall not contain any joints below slab.

D. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3.2 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install valves according to Section 220500 "Common Work Results for Plumbing."

D. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

G. Install piping to permit valve servicing.

H. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install PEX tubing with loop at each change of direction of more than 90 degrees.

L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

M. Comply with requirements in Section 220500 “Common Work Results for Plumbing” for the following:

1. Install Install sleeves for piping penetrations of walls, ceiling, and floors.
2. Install sleeve seals for piping penetrations of concrete walls and slabs.
3. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads 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.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."

E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

F. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

G. Joints for PEX Tubing, ASTM: Join according to ASTM F1960 for cold expansion fittings and reinforcing rings.

H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings, nipples, or unions.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices in Section 220500 "Common Work Results for Plumbing."

B. Install hangers for copper tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping within 12 inches of each fitting.

D. Support vertical runs of copper tubing and piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Hydrostatic testing and documentation of test results for polypropylene piping to be in accordance with the manufacturer's instructions and submitted to the manufacturer upon successful completion per warranty requirements.
f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
g. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.12 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing valves.
2. Temperature-actuated, water mixing valves.
3. Strainers for domestic water piping.
4. Flexible connectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Bell & Gossett; a Xylem brand.

    b. Hydronic Components Inc.
    c. IMI Hydronic Engineering Inc.
    d. Jomar Valve.
    e. Nexus Valve, Inc.
    f. NIBCO INC.
    g. WATTS.

2. Type: **Ball** valve with two readout ports and memory-setting indicator.
3. Body: Brass.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.4 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Acorn Engineering Company; A Division of Morris Group International.
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    c. Cash Acme, A Division of Reliance Worldwide Corporation.
    d. Leonard Valve Company.
    e. POWERS; A WATTS Brand.
    f. Symmons Industries, Inc.
    g. Taco Comfort Solutions, Inc.
    h. WATTS.
    i. Zurn Industries, LLC.

2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 deg F.
9. Valve Finish: Chrome plated or rough bronze.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jomar Valve.
    b. Keckley Company.

c. Titan Flow Control, Inc.
d. WATTS.
e. Zurn Industries, LLC.

2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller.
4. End Connections: Threaded for NPS 2 and smaller.
5. Screen: Stainless steel with round perforations unless otherwise indicated.

2.6 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Innerlynx.
3. Mason Industries, Inc.
4. Metraflex Company (The).

B. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

B. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.

C. Y-Pattern Strainers: For water, install on supply side of each pump.

3.2 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ADJUSTING

A. Set field-adjustable flow set points of balancing valves.

B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

3.4 FIELD QUALITY CONTROL

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

B. Perform the following tests and inspections.

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Hubless, cast-iron soil pipe and fittings.
2. PVC pipe and fittings.
3. Specialty pipe fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AB & I Foundry; a part of the McWane family of companies.

2. Charlotte Pipe and Foundry Company.
3. NewAge Casting.
4. Tyler Pipe; a part of the McWane family of companies.

B. Pipe and Fittings: ASTM A 888 or CISPI 301.

C. Single-Stack Aerator Fittings: ASME B16.45, hubless, cast-iron aerator and deaerator drainage fittings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conine Manufacturing Co., Inc.
b. SE Sovent.

D. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Charlotte Pipe and Foundry Company.
c. Dallas Specialty & Mfg. Co.
d. Fernco Inc.
e. Ideal Clamp Products, Inc.
f. Josam Company.
g. Matco-Norca.
h. Mission Rubber Company, LLC; a division of MCP Industries.
i. Tyler Pipe; a subsidiary of McWane, Inc.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

E. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. MG Piping Products Company.

2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

E. Solvent Cement: ASTM D 2564.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2. Shielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cascade Waterworks Mfg. Co.
2) Mission Rubber Co; a division of MCP Industries.

b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. End Connections: Same size as and compatible with pipes to be joined.

B. Dielectric Fittings:

1. Dielectric Unions:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) A.Y. McDonald Mfg. Co.
2) Capitol Manufacturing Company.
3) Central Plastics Company.
4) HART Industrial Unions, LLC.
5) Jomar Valve.
6) Matco-Norca.
7) WATTS.
8) Wilkins.
9) Zurn Industries, LLC.

b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 125 psig minimum at 180 deg F.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

2. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Matco-Norca.
4) WATTS.
5) Wilkins.
6) Zurn Industries, LLC.

b. Description:

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.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

    a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    a. Reducing size of waste piping in direction of flow is prohibited.

J. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

K. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 2 percent downward in direction of flow for piping smaller than NPS 3; 1 percent downward in direction of flow for piping NPS 3 and larger.
2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow for piping smaller than NPS 3; 1 percent downward in direction of flow for piping NPS 4 and larger.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

N. Install aboveground PVC piping according to ASTM D 2665.

O. Install underground PVC piping according to ASTM D 2321.

P. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

    a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install drains in sanitary waste gravity-flow piping.

a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Comply with requirements for sleeves, sleeve seals, and escutcheons in Section 220500 “Common Work Results for Plumbing.”

1. Install sleeves for piping penetrations of walls, ceilings, and floors.
2. Install sleeve seals for piping penetrations of concrete walls and slabs.
3. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220500 "Common Work Results for Plumbing."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

E. Support vertical runs of cast iron soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

    a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.

    a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    c. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

    a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

A. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

B. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil piping; gaskets and gasketed joints or calking materials and calked joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI or cast-iron hubless-piping couplings; and coupled joints.
3. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints. PVC shall not be used where sanitary waste discharge could exceed 140 degrees F such as kitchens or boiler room drains.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Miscellaneous sanitary drainage piping specialties.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

A. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. Josam Company.
c. Sioux Chief Manufacturing Company, Inc.
d. WATTS.
e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required when floor utilizes a continuous waterproof membrane.
7. Outlet Connection: Inside calk.
8. Closure: ABS, brass, or bronze plug with tapered threads.

9. Adjustable Housing Material: **Cast iron** with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy, scoriated.
11. Frame and Cover Shape: Round.
12. Top-Loading Classification: Light Duty.
13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

B. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg Co; a division of Morris Group International.
    b. Josam Company.
    c. MIFAB, Inc.
    d. WATTS.
    e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:

    a. Brass.
    b. Countersunk **or raised** head.
    c. Drilled and threaded for cover attachment screw.
    d. Size: Same as or not more than one size smaller than cleanout size.

6. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
7. Wall Access, Frame and Cover: Round, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Inline Trap Seal:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg Co; a division of Morris Group International.
    b. Josam Company.
    c. RectorSeal Plumbing; a CSW Industrials Company.

2. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
3. Material: Polymer.
4. Standard: Tested and certified in accordance with ASSE 1072.
5. Listing: ICC-ES or IAPMO listed.
6. Size: Same as floor drain outlet or strainer throat.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

B. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

C. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

3.2 PIPING CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 221319.13 - SANITARY DRAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Floor drains.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg Co; a division of Morris Group International.
    b. Josam Company.
    c. Prier Products, Inc.
    d. Sioux Chief Manufacturing Company, Inc.
    e. Wade; a subsidiary of McWane Inc.
    f. WATTS.
    g. Zurn Industries, LLC.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required if installed in an area with a waterproof membrane.
6. Anchor Flange: Required if installed in an area with a waterproof membrane.
7. Clamping Device: Required if installed in an area with a waterproof membrane.
8. Outlet: Bottom.

9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Bronze.
13. Top of Body and Strainer Finish: Nickel bronze.
14. Top Shape: Round.
15. Top Loading Classification: Light Duty.

B. Plastic Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Endura; a division of IPEX.
    b. IPEX.
    c. IPS Corporation.
    d. Jay R. Smith Mfg. Co.
    e. Josam Company.
    f. Oatey.
    g. Plastic Oddities.
    h. Sioux Chief Manufacturing Company, Inc.
    i. Zurn Industries, LLC.

2. Standard: ASME A112.6.3.
3. Material: ABS, PVC, or polyprobylene.
4. Seepage Flange: Required if installed in an area with a waterproof membrane.
5. Clamping Device: Required if installed in an area with a waterproof membrane.
6. Outlet: Bottom.
7. Sediment Bucket: Not required.
8. Strainer Finish: Nickel bronze.
9. Top Shape: Round.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.

    a. Maintain integrity of waterproof membranes where penetrated.

5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.

D. Install piping adjacent to equipment to allow service and maintenance.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Hubless, cast-iron soil pipe and fittings.
2. PVC pipe and fittings.
3. Specialty pipe and fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pip and Foundry Company.
3. NewAge Casting.
4. Tyler Pipe; a part of the McWane family of companies.

B. Pipe and Fittings:

1. Marked with CISPI collective trademark and NSF certification mark.
2. Standard: ASTM A 888 or CISPI 301.

C. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ANACO-Husky.
   b. Charlotte Pip and Foundry Company.
   c. Dallas Specialty & Mfg. Co.
   d. Fernco Inc.
   e. Ideal Clamp Products, Inc.
   f. Matco-Norca.
   g. MIFAB, Inc.
   h. Mission Rubber Company, LLC; a division of MCP Industries.
   i. NewAge Casting.
   j. Tyler Pipe; a part of the McWane family of companies.

2. Couplings shall bear CISPI collective trademark.
3. Standards: ASTM C 1277 and CISPI 310.
4. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Charlotte Pip and Foundry Company.
   b. MG Piping Products Company.

2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 PVC PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Charlotte Pip and Foundry Company.
2. GF Piping Systems.
3. JM Eagle; J-M Manufacturing Co., Inc.
4. Mueller Industries, Inc.
5. National Pipe and Plastic, Inc.
6. North America Pipe Corporation.
7. Rocky Mountain Colby Pipe Company.
8. Silver-line Plastics.

B. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

C. Solid-Wall PVC Pipe: ASTM D 2665; drain, waste, and vent.

D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

E. Adhesive Primer: ASTM F 656.

F. Solvent Cement: ASTM D 2564.

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.

3. Shielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company, LLC; a division of MCP Industries.

b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. End Connections: Same size as and compatible with pipes to be joined.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) A.Y. McDonald Mfg. Co.
2) Capitol Manufacturing Company.
3) Central Plastics Company.
4) HART Industrial Unions, LLC.
5) Jomar Valve.
6) Matco-Norca.
7) WATTS.
8) Zurn Industries, LLC.

b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 150 psig minimum at 180 deg F.

3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Central Plastics Company.
2) Matco-Norca.
3) WATTS.
4) Zurn Industries, LLC.

b. Description:

1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 150 psig minimum at 180 deg F.
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.

1. Do not change direction of flow more than 90 degrees.
2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

a. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

K. Install piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping smaller than NPS 3; 1 percent downward in direction of flow for piping NPS 3 and larger.
2. Horizontal Storm Drainage Piping: 2 percent downward in direction of flow.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

M. Install aboveground PVC piping according to ASTM D 2665.

N. Install underground PVC piping according to ASTM D 2321.

O. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.

a. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."

2. Install drains in storm drainage gravity-flow piping.

a. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. Comply with requirements for sleeves, sleeve seals, and escutcheons in Section 220500 “Common Work Results for Plumbing.”

1. Install sleeves for piping penetrations of walls, ceilings, and floors.

2. Install sleeve seals for piping penetrations of concrete walls and slabs.
3. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Hubless, Cast-Iron Soil Piping Coupled Joints:

1. Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendices.

C. Joint Restraints and Sway Bracing:

1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:

a. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Drainage Piping: Shielded, nonpressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or nipples.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices specified in Section 220500 "Common Work Results for Plumbing."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

E. Support vertical cast-iron piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent, but as a minimum at base and at each floor.

F. Support vertical PVC piping with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
2. Comply with requirements for cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed storm drainage piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

    a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

3. Test Procedure:

    a. Test storm drainage piping on completion of roughing-in.
    b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

C. Piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

A. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

B. Underground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron, hubless-piping couplings; and coupled joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for penetrations of roofs.
2. Section 078413 "Penetration Firestopping" for firestopping roof penetrations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. Josam Company.
c. Marathon Roofing Products.
d. Sioux Chief Manufacturing Company, Inc.
e. Wade; a subsidiary of McWane Inc.
f. WATTS.
g. Zurn Industries, LLC.

2. Standard: ASME A112.6.4.

3. Body Material: Cast iron.
4. Dimension of Body: Nominal 14-to 16-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Not required.
7. Outlet: Bottom.
8. Outlet Type: No hub.
9. Extension Collars: Required.
10. Underdeck Clamp: Required.
11. Expansion Joint: Not required.
12. Sump Receiver Plate: Required.
13. Dome Material: PE.
14. Perforated Gravel Guard: Not required.
15. Vandal-Proof Dome: Not required.
16. Water Dam: 2 inches **high** for overflow applications.
17. Verify all roof drain variations and options with roof structure and insulation.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Metal Downspout Nozzles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg Co; a division of Morris Group International.
    b. Josam Company.
    c. WATTS.
    d. Zurn Industries, LLC.

2. Description: Nozzle with wall flange and mounting holes to cover rough opening and serve as anchor.
3. Size: Same as connected downspout.
4. Material: Cast bronze or nickel bronze nozzle and flange.
5. Piping Connection Type: No-hub.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg Co; a division of Morris Group International.
    b. Josam Company.
    c. Tyler Pipe; a subsidiary of McWane Inc.
    d. Wade; a subsidiary of McWane Inc.
    e. WATTS.
    f. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Body Material: No-hub, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg Co; a division of Morris Group International.
    b. Josam Company.
    c. Sioux Chief Manufacturing Company, Inc.
    d. WATTS.
    e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required when floor utilizes a continuous waterproof membrane.
7. Outlet Connection: Inside calk.
8. Closure: ABS, brass, or bronze plug with tapered threads.
9. Adjustable Housing Material: **Cast iron** with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy, scoriated.
11. Frame and Cover Shape: Round.
12. Top-Loading Classification: Light Duty.
13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg Co; a division of Morris Group International.
    b. Josam Company.
    c. MIFAB, Inc.
    d. WATTS.
    e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:

    a. Brass.
    b. Countersunk **or raised** head.
    c. Drilled and threaded for cover attachment screw.
    d. Size: Same as or not more than one size smaller than cleanout size.

6. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
7. Wall Access, Frame and Cover: Round, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

D. Test Tees:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. Josam Company.
c. Tyler Pipe; a subsidiary of McWane Inc.
d. WATTS.
e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M and ASTM A74, ASTM A888, or CISPI 301.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk or raised head, brass.
6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas in accordance with roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

B. Install downspout nozzles at exposed bottom of conductors where they spill onto grade.

C. Install cleanouts in aboveground piping and building drain piping in accordance with the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical storm piping conductor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install test tees in vertical conductors and near floor.

F. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

G. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 INSTALLATION OF FLASHING

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Electric, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Electric, Storage, Domestic-Water Heaters:

1) Storage Tank: Six years.
2) Controls and Other Components: Six years.

b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 ELECTRIC, DOMESTIC-WATER HEATERS

A. Small-Capacity, Electric, Domestic-Water Heaters:

1. Subject to compliance with requirements, provide products from one of the following:

    a. A. O. Smith.
    b. Bradford White.
    c. Rheem.

2. Standard: UL 174.
3. Storage-Tank Construction: Corrosion-resistant metal or porcelain enamel.

    a. Tappings: ASME B1.20.1 pipe thread.
    b. Pressure Rating: 150 psig.
    c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.

4. Factory-Installed, Storage-Tank Appurtenances:

    a. Drain Valve: Corrosion-resistant metal with hose-end connection if tank has drain outlet. Provide hose-end drain valve in piping for domestic-water heaters without drain outlet. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
    b. Insulation: Non-CFC foam or flexible fiberglass.
    c. Jacket: Steel with enameled finish or high-impact composite material.
    d. Heating Element: One; electric, screw-in immersion type.
    e. Temperature Control: Adjustable thermostat.
    f. Safety Control: High-temperature-limit cutoff device or system.
    g. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. A. O. Smith Corporation.
    b. AMTROL, Inc.
    c. Flexcon Industries.
    d. Honeywell International Inc.
    e. Pentair Pump Group.
    f. State Industries.
    g. Taco Comfort Solutions, Inc.

2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
3. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
4. Construction:

    a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
    b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    c. Air-Charging Valve: Factory installed.

5. Capacity and Characteristics:

    a. Working-Pressure Rating: 100 psig.
    b. Capacity Acceptable: 2 gal. minimum.

B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Holdrite.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.

D. Heat-Trap Fittings: ASHRAE/IES 90.1.

E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.

F. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

G. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

H. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220500 "Common Work Results for Plumbing."

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 domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

C. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains.

D. Install thermometers on outlet piping of electric, domestic-water heaters.

E. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

F. Fill electric, domestic-water heaters with water.

G. Charge domestic-water expansion tanks with air to required system pressure.

H. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wall-mounted water closets.
2. Flushometer valves.
3. Toilet seats.
4. Supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 WALL-MOUNTED WATER CLOSETS

A. Water Closets, Wall Mounted, Top Spud, Accessible:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Kohler Co.
c. Mansfield Plumbing Products LLC.
d. Sloan Valve Company.
e. TOTO USA, Inc.
f. Zurn Industries, LLC.

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.
d. Style: Flushometer valve.
e. Height: Standard.
f. Rim Contour: Elongated.
g. Water Consumption: 1.6 gal. per flush.
h. Spud Size and Location: NPS 1-1/2; top.

3. Flushometer Valve: Semi-red brass construction with synthetic rubber diaphragm.
4. Support: Water closet carrier.
5. Water-Closet Mounting Height: Standard and Handicapped/elderly according to ICC/ANSI A117.1. Refer to Architectural plans and elevations.

2.2 FLUSHOMETER VALVES

A. Solenoid-Actuator, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Delaney Products.
b. I-Con Systems, Inc.
c. Sloan Valve Company.
d. Zurn Industries, LLC.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Semi-red brass body with corrosion-resistant components. Synthetic rubber diaphragm.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
10. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
11. Consumption: 1.6 gal. per flush.
12. Minimum Inlet: NPS 1.
13. Minimum Outlet: NPS 1-1/4.

2.3 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Bemis Manufacturing Company.

c. Centoco Manufacturing Corporation.
d. Church Seats; Bemis Manufacturing Company.
e. Jones Stephens Corp.
f. Kohler Co.
g. TOTO USA, INC.
h. Zurn Industries, LLC.

2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Standard).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check; noncorroding metal.
7. Color: White.

2.4 SUPPORTS

A. Water Closet Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. Josam Company.
c. Wade Drains.
d. WATTS.
e. Zurn Industries, LLC.

2. Standard: ASME A112.6.1M.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

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

3.2 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Use carrier supports with waste-fitting assembly and seal.
2. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install actuators in locations that are easy for people with disabilities to reach.
4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224213.16 - COMMERCIAL URINALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wall-hung urinals.
2. Urinal flushometer valves.
3. Supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

A. Urinals, Wall Hung, Back Outlet, Washout, Accessible:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Kohler Co.
c. Mansfield Plumbing Products LLC.
d. Sloan Valve Company.
e. TOTO USA, INC.
f. Zurn Industries, LLC.

2. Fixture:

    a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    b. Material: Vitreous china.
    c. Type: Washout with extended shields.
    d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
    e. Water Consumption: Low.
    f. Spud Size and Location: NPS 3/4, top.
    g. Outlet Size and Location: NPS 2, back.
    h. Color: White.

3. Flushometer Valve: Semi-red brass construction with synthetic rubber diaphragm.
4. Waste Fitting:

    a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
    b. Size: NPS 2.

5. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture.
6. Urinal Mounting Height: Standard and Handicapped/elderly according to ICC A117.1. Refer to Architectural plans and details.

2.2 URINAL FLUSHOMETER VALVES

A. Solenoid-Actuator, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Delaney Products.
    b. I-Con Systems, Inc.
    c. Sloan Valve Company.
    d. Stern Engineering Ltd.
    e. Zurn Industries, LLC.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Semi-red brass construction with corrosion-resistant components, synthetic rubber diaphragm.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Actuator: Solenoid complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
10. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
11. Consumption: 1.0 gal. per flush.
12. Minimum Inlet: NPS 3/4.
13. Minimum Outlet: NPS 1-1/4.

2.3 SUPPORTS

A. Type I Urinal Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. Josam Company.
c. Wade Drains.
d. WATTS.
e. Zurn Industries, LLC.

2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.

B. Examine walls and floors for suitable conditions where urinals will be installed.

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

3.2 INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use carriers without waste fitting for urinals with tubular waste piping.
4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Wall Flange and Escutcheon Installation:

1. Install escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.

3. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Vitreous-china, wall-mounted lavatories.
2. Automatically operated lavatory faucets.
3. Supply fittings.
4. Waste fittings.
5. Lavatory supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Servicing and adjustments of automatic faucets.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory - Ledge Back, Vitreous China, Wall Mounted:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Kohler Co.
c. Mansfield Plumbing Products LLC.
d. Sloan Valve Company.

2. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For wall hanging.
c. Nominal Size: Rectangular, 20 by 18 inches.
d. Faucet-Hole Punching: Three holes, 4-inch centerset.
e. Faucet-Hole Location: Top.
f. Color: White.
g. Mounting Material: Chair carrier.

3. Lavatory Mounting Height: Standard and Handicapped/elderly in accordance with ICC A117.1. Refer to Architectural plans and details.

2.2 AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets - Automatic Type: Battery Powered Electronic Sensor Operated:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Modern Technologies Corporation – AMTC.
b. American Standard.
c. Bradley Corporation.
d. Chicago Faucets; Geberit Company.
e. GROHE America, Inc.
f. Kohler Co.
g. Moen Incorporated.
h. Sloan Valve Company.
i. Speakman Company.
j. Symmons.
k. T&S Brass and Bronze Works, Inc.
l. TOTO USA, INC.
m. Zurn Industries, LLC.

2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
3. 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.
4. General: Coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
5. Body Type: Mid integrated body, 3-hole with 4 inch centerset.
6. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 0.5 gpm.
9. Mounting Type: Deck, concealed.

10. Spout: Rigid.
11. Spout Outlet: Multi-laminar spray.

2.3 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.

D. Supply Stops: Lead-free convertible quarter-turn brass ball valve, chrome plated commercial pattern with convertible loose key handle. Inlet shall be compression, sweat, or IPS. Outlet shall be compression.

1. McGuire LFBV series.

E. Operation: Loose key.

F. Risers:

1. NPS 3/8.
2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpiece or ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless steel, flexible hose riser.

2.4 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4.
2. Material:

a. Seamless pre-wrapped, all-cast-brass ground joint swivel P-trap, less cleanout.

1) McGuire Manufacturing PW series.

2.5 LAVATORY SUPPORTS

A. Lavatory Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. Josam Company.
c. Wade; a subsidiary of McWane, Inc.

d. WATTS.
e. Zurn Industries, LLC.

2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

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

3.2 INSTALLATION

A. Install lavatories level and plumb in accordance with roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224216.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Stainless steel sinks.
2. Service sinks.
3. Sink faucets.
4. Supply fittings.
5. Waste fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics**[, electrical characteristics,]** and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL SINKS

A. Single Bowl Sink: Drop-in.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Engineering Company, Inc.
b. Elkay Manufacturing Company.
c. Just Manufacturing.

d. Kohler Co.
e. Moen Incorporated.

2. Fixture:

a. Standard: ASME A112.19.1/CSA B45.4 and NSF/ANSI 2.
b. Metal thickness: 18 gauge.
c. Dimensions: Refer to schedule.

3. Faucet:

a. NSF Standard: Comply with NSF 372 for faucet-spout materials that will be in contact with potable water.
b. Manual type, two lever handle.
c. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) American Standard.
2) Bradley Corporation.
3) Chicago Faucets; Geberit Company.
4) Delta Faucet Company.
5) Elkay.
6) GROHE America, Inc.
7) Just Manufacturing.
8) Kohler Co.
9) Moen Incorporated.
10) Sloan Valve Company.
11) Speakman Company.
12) T&S Brass and Bronze Works, Inc.
13) Zurn Industries, LLC.

d. Standard: ASME A112.18.1/CSA B125.1.
e. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
f. Body Type: Widespread.
g. Body Material: Commercial, solid brass.
h. Finish: Polished chrome plate.
i. Maximum Flow Rate: 1.5 gpm.
j. Handles: Wrist blade, 4 inches.
k. Mounting Type: Deck, exposed.
l. Spout Type: Swivel gooseneck.

2.2 SERVICE BASINS

A. Service Basins: Terrazzo, floor mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Engineering Company; a Division of Morris Group International.
b. Fiat Products.
c. Florestone Products Co., Inc.
d. Stern-Williams Co., Inc.

2. Fixture:

    a. Standard: IAPMO PS 99.
    b. Shape: **Five sided**.
    c. Nominal Size: 24 by 24 inches.
    d. Height: 12 inches.
    e. Tiling Flange: Not required.
    f. Rim Guard: On all top surfaces.
    g. Drain: Grid with NPS 3 outlet.

3. Mounting: On floor and flush to wall.
4. Faucet:

    a. Manual type, two lever handle, wall mounted, with top-mounted supplies upturned 90 degrees for surface mounting of supply lines.
    b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) American Standard.
        2) Bradley Corporation.
        3) Chicago Faucets; Geberit Company.
        4) Delta Faucet Company.
        5) Elkay.
        6) GROHE America, Inc.
        7) Just Manufacturing.
        8) Kohler Co.
        9) Moen Incorporated.
        10) Sloan Valve Company.
        11) Speakman Company.
        12) T&S Brass and Bronze Works, Inc.
        13) Zurn Industries, LLC.

    c. Standard: ASME A112.18.1/CSA B125.1.
    d. General: Include hot- and cold-water indicators.
    e. Body Type: Widespread.
    f. Body Material: Commercial, solid brass.
    g. Finish: Chrome plated
    h. Maximum Flow Rate: 2.2 gpm.
    i. Handle(s): Cross, four arm.
    j. Mounting Type: Back/wall, exposed.
    k. Spout Type: Rigid, solid brass with wall brace.
    l. Vacuum Breaker: Required for hose outlet.
    m. Spout Outlet: Hose thread.

2.3 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:

1. NPS 3/8.
2. Chrome-plated, rigid-copper pipe or ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

2.4 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2.
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.

2.5 GROUT

A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

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

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Set floor-mounted sinks in leveling bed of cement grout.

C. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220500 "Common Work Results for Plumbing."
2. Install stops in locations where they can be easily reached for operation.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 " Common Work Results for Plumbing."

E. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks. Replace damaged and malfunctioning sinks and fittings.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224716 - PRESSURE WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes ancillary components for owner furnished pressure water coolers.

1.3 ACTION SUBMITTALS

A. Owner Furnished Equipment.

1.4 CLOSEOUT SUBMITTALS

A. Owner Furnished Equipment.

PART 2 - PRODUCTS

2.1 OWNER FURNISHED

2.2 SUPPORTS

A. Type I Water Cooler Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg Co; a division of Morris Group International.
    b. Josam Company.
    c. Wade Drains.
    d. WATTS.
    e. Zurn Industries, LLC.

2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

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

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings.

B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220500 "Common Work Results for Plumbing."

D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

E. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING

A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 230100 - GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions as established by the Construction Manager apply to work of this section.

B. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

C. The items in this section are supplementary to the requirements set forth in other portions of the specifications as indicated under Item "A" above.

1.2 DRAWINGS

A. The drawings show the location and general arrangement of equipment, mechanical systems, and related items affected by this work.

1.3 DESCRIPTION

A. This section includes general provisions that are applicable to Division 23

1.4 SCOPE

A. The work covered by this Division of the Specifications consists of furnishing all labor, supervision, equipment, materials, all incidentals, related items and appurtenance, and performing all operations necessary to complete the installation of Work in strict accordance with the Sections under this Division of the Specifications and work indicated on the Drawings including that which is considered essential to the Contract Documents.

1.5 DRAWINGS AND SPECIFICATIONS

A. The mechanical drawings are diagrammatic in character.

B. All drawings related to this structure, together with these specifications, shall be considered in bidding. The drawings and specifications are complementary, and what is called for in either of these shall be as binding as though called for by both. Should any conflict arise between drawings and specifications, such conflict shall be brought to the attention of the Architect/Engineer for resolution.

1.6 GUARANTEE

A. The Contractor shall guarantee all materials, labor, workmanship, and the successful operation of all equipment and apparatus installed for a period of one year from the date of final acceptance of the entire work, not necessarily the manufacturer's guarantee of when it was installed, and shall guarantee to repair or replace at his own expense any part of the apparatus

which may show defect during that time, provided such defect is, in the opinion of the Architect/Engineer, due to imperfect material or workmanship and not due to carelessness or improper use.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION OF SITE

A. The Contractor shall visit and examine the premises and/or job site so as to ascertain the existing conditions before bidding. No extras will be allowed due to lack of knowledge of these conditions.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section covers basic materials and methods which may be common to two or more subsequent sections.

1.2 QUALITY ASSURANCE

A. Chemical and physical properties of all materials, design, performance characteristics and methods of construction of all items of equipment shall be in accordance with the following applicable regulations, references, and standards of current editions in effect 30 days prior to receipt of bids:

1. American Society of Heating, Refrigerating, Air Conditioning Engineers (ASHRAE)
2. American Society of Mechanical Engineers (ASME).
3. American Society for Testing and Materials (ASTM).
4. Factory Mutual Laboratories (FM).
5. National Electrical Manufacturer's Association (NEMA).
6. National Fire Protection Association (NFPA).
7. Plumbing and Drainage Institute (PDI).
8. Underwriters' Laboratories, Inc. (UL).
9. American National Standards Institute (ANSI).

B. All work, materials and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, where applicable, shall take precedence over these drawings and specifications.

C. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

1.3 MATERIALS AND MANUFACTURERS

A. Unless otherwise noted all materials and equipment shall be new, free of defects, installed in accordance with manufacturer's current published recommendations in a neat manner and in accordance with standard practice of the industry.

B. Certain materials and/or equipment in this specification are specified by manufacturer and catalog numbers. The design was based on the specified equipment and establishes a degree of quality, performance, physical configuration, etc. If the Contractor should elect to use equipment other than the equipment used as a basis for design but listed as "acceptable" in the Specifications, Contractor shall be responsible for space requirements, configuration, performance, and changes in, bases, supports, vibration isolators, structural members, openings in structure and other apparatus that may be affected by its use.

C. Contractor further agrees that if deviations, discrepancies, or conflicts between reviewed submittals and shop drawings, and the Contract Documents in the form of design drawings and specifications are discovered after submittals and/or shop drawings are processed by

the Architect/Engineer, the design drawings and specifications shall control and shall be followed at no additional cost to Owner or Engineer.

1.4 SUBSTITUTION APPROVALS

A. Equipment and/or materials manufactured by any one of the manufacturers listed in this specification or on the drawings shall be acceptable.

B. Where no specific manufacturer is listed, a first-class item of cataloged manufacturer shall be furnished.

C. Where specifications list a manufacturer and then state, ‘or approved equal,’ it shall be the contractor’s responsibility to obtain in writing the Engineer’s approval of the proposed ‘equal’ product prior to bids. Contractor shall not simply assume a product will be approved ‘as equal’ based on supplier representatives’ verbal statements.

1.5 QUIET OPERATION AND VIBRATION

A. All mechanical equipment provided under this contract shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Architect/Engineer. In case of moving machinery, sound, or vibration noticeable outside of its own room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Architect/Engineer shall be corrected in an approved manner by the Contractor at his expense. Vibration control shall be by means of approved vibration eliminators in a manner as recommended by the manufacturer of the eliminators.

1.6 PERMITS AND INSPECTIONS

A. Mechanical contractor shall file for, pay all fees, and obtain all applicable mechanical and other permits required to receive approvals for occupancy and use of the premises.

B. Contractor shall call for, and ascertain, all inspections are completed and approvals obtained for the work prior to submitting an application for final payment.

PART 2 - PRODUCTS

2.1 VALVES

A. All valves, except as otherwise specified in detail specifications, shall be of one manufacturer: Victaulic, Apollo, Milwaukee Valve, Crane, Kennedy, Jenkins, Hammond, Powell, or Nibco (gate valves - block pattern) and are to be manufactured in accordance with the Manufacturer's Standardization Society of the Valves and Fittings Industry Standards wherever applicable.

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section covers basic materials and methods which may be common to two or more subsequent sections.

1.2 QUALITY ASSURANCE

A. Chemical and physical properties of all materials, design, performance characteristics and methods of construction of all items of equipment shall be in accordance with the following applicable regulations, references, and standards of current editions in effect 30 days prior to receipt of bids:

1. American Society of Heating, Refrigerating, Air Conditioning Engineers (ASHRAE)
2. American Society of Mechanical Engineers (ASME).
3. American Society for Testing and Materials (ASTM).
4. Factory Mutual Laboratories (FM).
5. National Electrical Manufacturer's Association (NEMA).
6. National Fire Protection Association (NFPA).
7. Plumbing and Drainage Institute (PDI).
8. Underwriters' Laboratories, Inc. (UL).
9. American National Standards Institute (ANSI).

B. All work, materials and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, where applicable, shall take precedence over these drawings and specifications.

C. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

1.3 MATERIALS AND MANUFACTURERS

A. Unless otherwise noted all materials and equipment shall be new, free of defects, installed in accordance with manufacturer's current published recommendations in a neat manner and in accordance with standard practice of the industry.

B. Certain materials and/or equipment in this specification are specified by manufacturer and catalog numbers. The design was based on the specified equipment and establishes a degree of quality, performance, physical configuration, etc. If the Contractor should elect to use equipment other than the equipment used as a basis for design but listed as "acceptable" in the Specifications, Contractor shall be responsible for space requirements, configuration, performance, and changes in, bases, supports, vibration isolators, structural members, openings in structure and other apparatus that may be affected by its use.

C. Contractor further agrees that if deviations, discrepancies, or conflicts between reviewed submittals and shop drawings, and the Contract Documents in the form of design drawings and specifications are discovered after submittals and/or shop drawings are processed by

the Architect/Engineer, the design drawings and specifications shall control and shall be followed at no additional cost to Owner or Engineer.

1.4 SUBSTITUTION APPROVALS

A. Equipment and/or materials manufactured by any one of the manufacturers listed in this specification or on the drawings shall be acceptable.

B. Where no specific manufacturer is listed, a first-class item of cataloged manufacturer shall be furnished.

C. Where specifications list a manufacturer and then state, ‘or approved equal,’ it shall be the contractor’s responsibility to obtain in writing the Engineer’s approval of the proposed ‘equal’ product prior to bids. Contractor shall not simply assume a product will be approved ‘as equal’ based on supplier representatives’ verbal statements.

1.5 QUIET OPERATION AND VIBRATION

A. All mechanical equipment provided under this contract shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Architect/Engineer. In case of moving machinery, sound, or vibration noticeable outside of its own room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Architect/Engineer shall be corrected in an approved manner by the Contractor at his expense. Vibration control shall be by means of approved vibration eliminators in a manner as recommended by the manufacturer of the eliminators.

1.6 PERMITS AND INSPECTIONS

A. Mechanical contractor shall file for, pay all fees, and obtain all applicable mechanical and other permits required to receive approvals for occupancy and use of the premises.

B. Contractor shall call for, and ascertain, all inspections are completed and approvals obtained for the work prior to submitting an application for final payment.

PART 2 - PRODUCTS

2.1 VALVES

A. All valves, except as otherwise specified in detail specifications, shall be of one manufacturer: Victaulic, Apollo, Milwaukee Valve, Crane, Kennedy, Jenkins, Hammond, Powell, or Nibco (gate valves - block pattern) and are to be manufactured in accordance with the Manufacturer's Standardization Society of the Valves and Fittings Industry Standards wherever applicable.

B. Ball valves shall be used in lieu of gate valves wherever the pressure and temperature ratings of same are satisfactory for the intended service and valve can be operated easily from floor or platform.

C. Listed manufacturer's numbers in detailed specifications are for cross reference purposes

D. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.1 for power piping valves.
7. ASME B31.9 for building services piping valves.

E. Ball Valves:

1. NPS 2 and Smaller:

a. Brass (Dezincification Resistant Brass Alloy, Lead-Free):

1. Standard: MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig, non-shock.
4. Body Design: Two piece.
5. Body material: Forged brass.
6. Ends: Threaded or solder.
7. Seats: PTFE.
8. Stem: Brass, blow-out proof.
9. Ball: T.E.A. (ternary eco alloy) coated brass.
10. Port: Full.

2. NPS 2-1/2 and Larger:

a. Iron, Class 125:

1. Standard: MSS SP-72.
2. CWP Rating: 200 psig, non-shock.
3. Body Design: Split body.
4. Body material: ASTM A126, gray iron.
5. Ends: Flanged.
6. Seats: PTFE.
7. Stem: Stainless steel, blow-out proof.
8. Ball: Stainless steel.
9. Port: Full.

b. Steel, Class 150

1. Standard: MSS SP-72.
2. CWP Rating: 285 psig, non-shock.
3. Body Design: Split body.
4. Body material: Carbon steel, ASTM A216, Type WCB.
5. Ends: Flanged.
6. Seats: PTFE.

7. Stem: Stainless steel, blow-out proof.
8. Ball: Stainless steel, vented.
9. Port: Full.

F. Butterfly Valves:

1. NPS 2-1/2 and Larger

a. Iron, Single-Flange with Ductile-Iron Disc:

1. Standard: MSS SP-67.
2. CWP Rating: 200 psig, non-shock.
3. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
4. Body material: ASTM A126, cast iron or ASTM A536 ductile iron.
5. Seats: EPDM.
6. Stem: One-or two-piece stainless steel.
7. Disc: Nickel-plated or -coated ductile iron.

b. Iron, Grooved-End:

1. Standard: MSS SP-67, Type 1.
2. CWP Rating: 175 psig, non-shock.
3. Body material: Coated, ductile iron.
4. Stem: Two-piece stainless steel.
5. Disc: Coated, ductile iron.
6. Seal: EPDM.

c. Single-Flange, High-Performance, Class 150 (Steam applications):

1. Standard: MSS SP-68.
2. CWP Rating: 1285 psig at 100 deg F.
3. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
4. Body material: Carbon steel, cast iron, ductile iron, or stainless steel.
5. Seat: Reinforced PTFE or metal.
6. Stem: Stainless steel, offset from seat plane.
7. Disc: Carbon steel.
8. Service: Bidirectional.

G. Recirculation System Balancing Valves:

1. One piece non-ferrous brass/bronze flow measuring and balancing shut-off valve combination rated to 150 psig. Flow element shall be a low loss/high signal Venturi or orifice meter equipped with pressure and temperature test ports and caps. Valve shall be ball type with Teflon seats and blow-out-proof stem with Teflon packing. Valves shall provide positive shut-off, memory stop, and union, equal to Circuit Setter by Bell & Gossett.

H. Swing Check Valves:

1. NPS 2 and Smaller:

a. Bronze with Bronze Disc, Class 125:

1. Standard: MSS SP-80, Type 3.
2. CWP Rating: 200 psig.
3. Body Design: Horizontal flow.
4. Body Material: ASTM B62, bronze.
5. Ends: Threaded or solder.

2. NPS 2-1/2 and Larger:

a. Iron with Metal Seat, Class 125:

1. Standard: MSS SP-71, Type 1.
2. CWP Rating: 200 psig, non-shock.
3. Body Design: Clear or full waterway.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Bronze.
7. Gasket: Asbestos free.

b. Iron with Metal Seat, Grooved-End:

1. CWP Rating: 300 psig, non-shock.
2. Body material: ASTM A536, ductile iron.
3. Seal: EPDM.
4. Disc: Spring-operated, ductile iron or stainless steel.
5. Can be installed vertically (flow upwards only) or horizontally.
6. Victaulic series 716.

c. Iron, Dual-Plate with Metal Seat, Class 125, Grooved-End:

1. Standard: API 594.
2. CWP Rating: 200 psig, non-shock.
3. Body Design: Wafer, spring-loaded plates.
4. Body Material: ASTM A126, gray iron.
5. Seat: Bronze
6. Victaulic series W715.

d. Iron, with Lever- and Spring-Closure Control, Class 125:

1. Standard: MSS SP-71, Type 1.
2. CWP Rating: 200 psig, non-shock.
3. Body Design: Clear or full waterway.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Bronze:
7. Gasket: Asbestos free.
8. Closure control: Factory-installed, exterior lever and spring.

e. Iron, Compact-Wafer, Center-Guided with Metal Seat, Class 125:

1. Standard: MSS SP-125.
2. CWP Rating: 200 psig, non-shock.
3. Body Material: ASTM A126, gray iron.
4. Ends: Flanged.
5. Style: Compact wafer.
6. Seat: Bronze:

3. Class 150 valves meeting the above specifications may be used where system pressure requires.
4. Alternative check valves (2½" and larger) shall be class 125/250 iron body, bronze mounted, wafer check valve, with ends designed for flanged type connection, aluminum bronze disc, EPDM seats, 316 stainless steel torsion spring, and hinge pin.
5. A spring-actuated check valve is to be used on pump discharge. Swing check with outside lever and spring (not center guided) is to be used on sewage ejectors or storm-water sump pumps.

I. Valves in insulated piping shall include a 2-inch stem extension, extended operating handle of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation, and memory stops that are fully adjustable after insulation is applied.

2.2 HANGERS AND SUPPORTS

A. Pipe hangers shall be manufactured of the same material as the pipe or be non-corrosive to the piping system to which it serves.

B. Multiple pipe runs may be supported on trapeze hangers. Trapeze shall be Unistrut P-100. Hanger rods shall be one size larger than size specified herein for largest pipe on trapeze. Where trapeze lengths exceed 42", additional hanger rod shall be installed at midspan.

C. Except where governed by local codes, maximum hanger spacing and minimum hanger rod sizes shall conform to the following table:

	Pipe Size	Spacing	Hanger Rod
Copper Pipe	1/2"	6'-0"	3/8"
	3/4" thru 1"	8'-0"	3/8"
Plastic Pipe (PVC)	1-1/4", 1-1/2"	4'-0"	3/8"
	2"	5'-0"	3/8"

2.3 THERMOMETERS

A. Approved manufacturers are Duro Instrument Corp., Miljoco, and H.O. Trerice Co.

B. Thermometers shall have cast aluminum case with baked enamel finish; red reading tube with suitable 9" scale; adjustable multi-angle housing, and brass separable socket.

2.4 PRESSURE GAUGES

A. Approved manufacturers are Duro Instrument Corp., Miljoco, H.O. Trerice Co., and Ametek U.S. Gauge Division.

B. Pressure gauges sall have phenolic turret case, 4-1/2” dial with suitable range, phosphorous bronze Bourdon tube, corrosion-resistant movement, adjustable stainless steel pointer, 1% of full scale accuracy, and 1/4" NPT brass connection.

C. Furnish the following with each pressure gauge: 1/4" brass needle valve (Hammond IB415), pressure snubber (Ray Model 1).

2.5 ELECTRICAL EQUIPMENT

A. All electrical equipment shall conform to the electrical specifications and shall be suitable for operation on the voltage and phase available at the building site. These characteristics shall be verified by the Contractor prior to ordering equipment.

B. Provide motors as required for proper operation of all equipment furnished under this Division.

1. Minimum motor horsepower ratings are specified or scheduled on the drawings. Minimum requirements for all motors are as follows:

2.6 Constructed for operation at work site altitude and surrounding temperature.
2.7 Dustproof/leakproof bearing rings.
2.8 Built to NEMA standards.
2.9 Factory balanced.
2.10 Open drip proof unless noted otherwise.
2.11 Integral thermal overload protection.

C. When not specifically noted under Division 26 or electrical drawings, provide the following:

1. Furnish all necessary control devices such as speed controls, transformers and relays as required for proper operation of all equipment furnished under this Division.
2. Furnish identification as to purpose for each switch and/or pushbutton station furnished herein. Identification may be either engraved plastic sign or permanent mounting to wall below switch, or stamping on switch cover proper. All such identification signs and/or switch covers in finished areas shall match other hardware in the immediate area.

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE OF MATERIALS

A. Make provisions for the delivery and safe storage of materials and make the required arrangements with other contractors for the introduction into the building of equipment too large to pass through finished openings.

3.2 PIPE AND FITTINGS

A. Piping is to be installed as shown on the drawings insofar as practical. When a pipe size is not indicated the subcontractor shall request the pipe size from the Architect/Engineer through the general contractor.

B. Provide sufficient swing joints, anchors, expansion loops, and/or devices necessary and install to permit free expansion and contraction without causing undue stresses. Make all changes in direction with fittings. Support piping independently at all equipment so that its weight shall not be supported by the equipment.

C. For water systems, Victaulic flexible couplings may be used on header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops (as approved by the engineer). Where loops are required, use flexible-type couplings on the loops.

D. Install piping without springing or forcing and clear all windows, doors, and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted.

E. All pipe shall be reamed to full pipe diameter before joining.

F. Install vertical risers plumb and straight, horizontal lines parallel with walls and partitions.

G. Provide shut-off valves and unions suitably located to isolate each item of equipment, branch circuit or section of piping.

H. Unions and flanges for servicing and disconnect are not required in installations using grooved joint couplings. (The couplings shall serve as disconnect points.)

I. Provide 1/2" drain valves at all low points of each system to enable complete drainage.

J. Provide dielectric unions or waterway fittings at all junctions of dissimilar metals in fresh water systems.

K. Grooved joint shall be installed in accordance with the manufacturer’s written recommendations. Grooved ends shall be clean and free from indentations, projections, or roll marks. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service. The coupling manufacturer’s factory trained representative shall provide on-site training for the contractor’s field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor’s representative is not considered qualified to conduct the training.)

L. All piping shall be adequately supported from the buildings structural framing system with adjustable hangers to maintain grading where required and to prevent sagging and pocketing.

M. Provide supports between piping and building structure where necessary to prevent swaying.

N. The use of wire or perforated metal to support pipe will not be permitted.

O. Do not install back-to-back change of direction or offset fittings such as ells and tees without a minimum of 3" nipple for the purposes of insulating the pipe properly.

3.3 CLEARANCE TO ELECTRICAL PANELS

A. In no case shall an exposed metallic pipe conveying any water or gas be located closer than 36” from the front or sides of a Motor Control Center (MCC), electrical breaker/fuse panel or transformer per NEC codes. When a pipe appears to be shown on the plans near an electrical breaker panel or transformer, adjust the routing and position of that pipe or piping accordingly.

B. If the contractor deems that an extra is required to make the necessary offsets in a pipe for whatever reason, contact the engineer before installing the piping within 36”. Any cost to relocate a pipe once installed to close to an electrical panel will be the responsibility of the contractor.

C. For MCC panels more than 800 amps, additional clearance requirements of 72” should be adhered to.

3.4 MECHANICAL WIRING

A. Provide all temperature control wiring, all interlock wiring, and equipment control wiring for the equipment that is to be provided under this Division unless specifically shown on electrical drawings.

B. All wiring shall be not less than No. 14 insulated color-coded wire in thin wall conduit.

C. The following schedule is intended to summarize the division of work and material responsibilities between the mechanical contractor and the electrical contractor.

ITEM	FURNISHED BY	SET BY	POWER WIRING	CONTROL WIRING
Fused and unfused disconnect switches	EC/MC	EC	EC	
Control relays and transformers	MC	MC	EC	MC
Thermostats, time switches*	MC	MC	EC	MC
Temperature control panels	MC	MC	EC	MC
Refrigeration equipment and controls	MC	MC	EC	MC

MC = Mechanical Contractor
EC = Electrical Contractor

* Motor driven units which are controlled from line voltage automatic controls such as line voltage thermostats, float switches or time switches which conduct full load current of the motor shall be wired for both power and control circuit under the electrical contract. However, if the control device does not conduct full load current, then the responsibility shall be set forth in the above schedule. (Example: a 208-volt, 3-phase, 3-wire motor requires 120-volt control. Electrical contractor shall

furnish a 120-volt circuit for control and 208-volt circuit for power and wire the power circuit. Mechanical contractor shall wire the control circuit).

(a) Wiring from alarm contacts to alarm system by EC; all control function wiring by MC. MC to coordinate location with EC.

3.5 OPERATION INSTRUCTIONS

A. Upon completion of all work and all tests, Contractor shall furnish the necessary skilled labor for operating all systems and equipment installed under this Division. The purpose is to demonstrate the workability of all systems and to instruct the Owner or their representative fully in the operations, adjustment, and maintenance of all equipment furnished utilizing the appropriate sections of the maintenance manual as a reference guide. Give at least 48 hours notice to the Owner and Architect/Engineer in advance of this period.

3.6 ACCEPTANCE TEST

A. After the final air and water balance test, all environmental systems shall be tested to prove satisfactory performance of all units.

B. The entire air conditioning system shall be tested during first cooling season following the completion of the mechanical systems; and it shall be established that all controls are calibrated accurately and performing properly and that all units are cooling satisfactorily.

C. The entire ventilation system shall be tested at the completion of the project; and it shall be established that controls are performing properly and that all rooms are being ventilated satisfactorily.

D. Check all duct smoke detectors and freezestats to assure that they are functioning properly.

3.7 MAINTENANCE

A. The Contractor shall provide the necessary skills and labor to assure the proper operation of and to provide all required maintenance for all equipment and controls provided under Division 23 for a period of one year after substantial completion of the contract as defined in paragraphs B through D below.

B. The Contractor shall receive calls for all problems experienced in the operation of the equipment provided under Division 23 and shall take steps to immediately correct any deficiencies that may exist.

C. All equipment that requires repairing shall be immediately serviced and repaired. Since the period of maintenance runs for one year concurrently with the warranty and guarantee, all parts and labor shall be furnished at no extra cost to Owner (including all controls).

D. When emergency service is required beyond working hours to maintain the system in operation, the Contractor shall furnish such service.

3.8 SCAFFOLDING, RIGGING, HOISTING

A. Provide all scaffolding, rigging, hoisting, and services necessary for delivery, erection, and placement within the premises of any equipment and apparatus furnished. Remove same from premises when no longer required.

3.9 THERMAL CONTINUITY

A. Where openings are created for duct work, piping, outdoor intake ducts, or any type of mechanical equipment penetration thru an insulated wall, roof, or partition, Mechanical Contractor shall be responsible for providing an air tight seal against air infiltration.

B. Where openings are larger than 1/4”, Mechanical Contractor shall fill opening with an insulation matching the existing R-value of the thermal barrier, but no less than R-18 for walls and R-30 for roofs, and then seal air tight.

3.10 WATERPROOFING

A. Where any work pierces waterproofing, the method of installation shall be as approved by the Architect/Engineer before work is done. Contractor shall furnish all necessary sleeves, caulking, and flashing required to make openings watertight.

3.11 ESCUTCHEON PLATES

B. Escutcheon plates shall be provided for all exposed uninsulated pipes passing through walls, floors, ceilings, into cabinets, or other areas where visibly seen by occupants of the facility. Plates shall be nickel plated metal of the split ring type and of size to match the pipe or conduit. Where plates are provided for pipes passing through sleeves which extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.

C. Plates for water supply penetrations serving sinks or water closets shall be on-piece non-split ring.

3.12 REMOVAL AND RELOCATION OF EXISTING PIPING AND/OR EQUIPMENT

A. The layout of the existing mechanical system as shown on the drawings has been prepared from existing building drawings and from inspection of the site. All data shown is the most accurate that is available at this time. Contractor shall visit the site to determine the exact quantities and the extent of equipment and piping to be removed and/or relocated prior to bid.

B. All materials to be removed shall become the property of the Contractor and shall be removed from the site unless specifically otherwise indicated on the drawings and/or tagged by Owner.

C. The Owner has the right of first refusal of all removed equipment and materials.

3.13 ACCESS DOORS

A. Mechanical Contractor shall provide and locate all required access doors where they may be required to service equipment, valves, dampers, etc. in inaccessible ceilings and walls. General Trades Contractor shall install.

3.14 INSTALLATION

A. Unless otherwise specifically indicated on the plans or specifications, all equipment and materials shall be installed in accordance with the recommendations of the manufacturer. Maintain maximum headroom and space conditions at all points.

3.15 ACCESSIBILITY

A. Locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include, but not be limited to, dampers, valves, traps, clean-outs, motors, controllers, switchgear, and drain points. If required for better accessibility, locate access doors for this purpose. Minor deviations from drawings may be made to allow for better accessibility.

3.16 CLEAN-UP

A. At the completion of work, all equipment on the project shall be checked and thoroughly cleaned including coils, plenum, under equipment and all other areas around or in equipment provided under this Section. Clean all exposed surfaces of all piping, hangers, ducts, and other exposed metal of all grease, plaster, or other foreign material. Remove all stick-on labels and clean surfaces.

B. At the completion of each work day, remove from the building, the premises, and surrounding streets, alleys, etc., all rubbish and debris resulting from the operations and leave all equipment spaces clean and ready for use.

3.17 DAMAGED SURFACES

A. At the completion of work, all mechanical equipment furnished under this contract shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet, jacket, or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.18 SLEEVES AND INSERTS

A. The contractor shall provide and locate all sleeves and inserts required before the floors and walls are built, or shall be responsible for the cost of cutting and patching required to facilitate installation after walls or floors are constructed.

B. Each contractor shall be responsible for any drilling required for installation of hangers.

C. Where pipe motion due to expansion or contraction will occur, make interior wall sleeves of sufficient diameter to permit free movement of pipe and insulation.

D. All sleeves shall be constructed of steel pipe unless otherwise noted on the drawings or specifically specified for a particular installation.

3.19 OLD PIPE LINES

A. Old sewer, water, steam, or other pipes encountered which interfere with the proper installation of new work and which will not be used in connection with the new work, shall have openings closed in a proper manner concealed in wall; or, if necessary, relocate or remove the pipes as directed by the Architect/Engineer.

3.20 COORDINATION AND COOPERATION WITH OTHER TRADES

A. The Contractor for this work shall examine the drawings and specifications for other parts of the work, and if head room or space conditions appear inadequate, or if any discrepancies occur between the plans and their work and the plans for the work of others, they shall report such discrepancies to the Architect/Engineer and shall obtain written instructions for any changes necessary to accommodate their 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.

B. Where the mechanical work will be installed near, or will interfere with work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than 1/4" = 1'-0", clearly showing their work is to be installed in relation to the work of other trades. If the Contractor installs their work before coordinating with other trades, or so as to cause any interference with work of other trades, they shall make the necessary changes in their work to correct the condition without extra charge.

3.21 RECORD OF CHANGES

A. Show on blue line prints in red ink all changes from original plans made during installation of work and file with Architect/Engineer when work is complete.

B. Coordinate with Division 1 for "As-Built" drawings and specification requirements.

3.22 SURVEY AND MEASUREMENTS

A. Base all measurements, both horizontal and vertical, on established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.

B. If any discrepancy between actual measurements and those indicated is discovered, which prevents following good practice or the intent of the drawings and specifications, the Architect shall be notified through the general Contractor, and work shall not proceed until instructions are received from the Architect.

3.23 PROTECTION

A. The Contractor shall protect all work and material from damage by his work or workmen, and shall be liable for all damage thus caused.

B. The Contractor shall be responsible for work and equipment until finally inspected, tested, and accepted; protecting work against theft, injury, or damage; and shall carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.24 RESPONSIBILITY OF CONTRACTOR

A. The Contractor is responsible for the complete and satisfactory installation of the work in accordance with the intent of the drawings and specifications. They shall provide, without extra charge, all incidental items required, as part of his work, even though not particularly specified or indicated. The installation shall be so made that its several component parts will function together as a workable system and shall be left with all parts adjusted and in working order.

3.25 EQUIPMENT ON ROOFS OR ELEVATED SURFACES

A. Do not locate mechanical appliances, equipment, or fans that require service within 10-feet of a roof edge or open side of a walking surface located more than 30" above the floor, roof, or grade below. Where equipment is placed closer than described herein, guards shall be furnished with top of the guard located not less than 42" above the elevated surface adjacent to the guard. The guard shall be constructed to prevent the passage of a 21-inch diameter sphere and shall comply with the loading requirements for guards specified in the Building Code.

3.26 PENETRATION OF FIRE AND SMOKE BARRIERS

A. Penetrations of floor, wall and/or ceiling assemblies required to have a fire or smoke resistance rating shall be protected in accordance with all applicable codes and as further described in Division 23 specification sections.

3.27 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare operation and maintenance manuals which shall cover all systems installed under Division 23.

B. The manuals shall be submitted to the Engineer in draft form for approval prior to preparation of three copies for final submission to the Architect for delivery to the Owner.

C. The manuals shall be 8-1/2" x 11" size and assembled in loose-leaf three ring or post binders. The manual shall be adequately indexed and contain the following information.

1. Contractors' names, addresses, and telephone numbers.
2. Alphabetical list of all system components with the names and addresses, and 24-hour phone number of the companies responsible for servicing each item during the warranty period.
3. Guarantees and warranties of all equipment whenever applicable.
4. All manufacturer's data that are applicable to the installed equipment such as the following:

    a. Shop drawings.
    b. Installation instructions.
    c. Lubrication instructions.
    d. Wiring diagrams.

5. All equipment shall be clearly identified as to the model, size, flow data, electrical characteristics, and other design and sizing parameters as may be applicable to the actual installed piece of equipment or systems described.
6. A simplified description of the operation of all systems including the function of each system, and piece of equipment within a system. These descriptions shall be supported with a schematic flow diagram when applicable.
7. Temperature control diagrams including an explanation of the control sequence of each system along with the following instruction whenever applicable.

    a. Emergency procedures for failure of major equipment.
    b. Normal starting, operating and shutdown.
    c. Summer or winter shutdown.

8. System Balancing report.
9. Valve tag list when applicable.
10. An outline of a preventative maintenance program for each system or item of equipment, and shall include a schedule of inspection and maintenance. It shall suggest the maintenance and inspection that should be performed by the owner and that which should be completed with outside service.

3.28 DUST PROTECTION

A. During demolition, work will be performed in areas where dust can be a nuisance to occupants or cause operating difficulties to equipment. The contractor shall take appropriate measures to minimize production of dust and provide dust barriers to separate the work area in an approved method to minimize dirt and dust migration with the use of tarpaulins, plastic enclosures, temporary walls, or other means as necessary, to be approved by the Owner.

B. The Contractor may, with approval of Owner, wet down concrete and masonry surfaces being demolished, but the contractor shall also provide means to control water migration to adjoining spaces, provide means to remove water which may accumulate due to this wetting process, and be responsible for any structural or occupants' material damage caused from the use of water.

3.29 PATCHING AND REPAIR OF EXISTING OPENINGS

A. The plumbing contractor shall include within their bid unless specifically noted in the plans or specifications for another trade to complete the work, the material and labor for all infilling, patching and repair of existing openings through walls, floors or roofs that remain when plumbing systems such as pipe or other equipment are removed.

B. Unless specifically noted on the plans, the repair shall be of same material and color as the original surface being repaired. In the event the material being patched is not available or cannot be matched, consult the architect for a suitable material that can be used.

C. Employee or sub-contractor the work of infilling, patching, and repairing to a professional trade person skilled in the use of materials being used for the repair.

D. Include all painting or finishing of the surface to match existing color and texture.

E. Include the installation and repair of all trim, base molding, flooring, and other surface treatments when the mechanical work requires to provide a finished look to match all surrounding materials and surfaces.

3.30 PAINTING EXTERIOR FERROUS PIPING

A. All exterior ferrous piping shall be primed and painted.

B. Contractor shall grind the pipe smooth.

C. Clean piping and make ready for paint.

D. Prime all exterior piping with metal primer.

E. Paint with two coats of industrial enamel.

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Carlton Industries, LP.
d. Champion America.
e. Craftmark Pipe Markers.
f. Emedco.
g. Kolbi Pipe Marker Co.
h. LEM Products Inc.
i. Marking Services, Inc.

j. Seton Identification Products; a Brady Corporation company.

2. Material and Thickness: Brass, 0.032-inch; stainless steel, 0.025-inch; aluminum, 0.032-inch; or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Carlton Industries, LP.
d. Champion America.
e. Craftmark Pipe Markers.
f. Emedco.
g. Kolbi Pipe Marker Co.
h. LEM Products Inc.
i. Marking Services, Inc.
j. Seton Identification Products; a Brady Corporation company.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.
6. Emedco.
7. LEM Products Inc.
8. Marking Services, Inc.
9. Natinal Marker Company.
10. Seton Identification Products; a Brady Corporation company.
11. Stranco, Inc.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

C. Letter Color: White.

D. Background Color: Red.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel **rivets** or self-tapping screw].

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Actioncraft Products, Inc; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Brimar Industries, Inc.
4. Carlton Industries, LP.
5. Champion America.
6. Craftmark Pipe Markers.
7. Emedco.
8. Kolbi Pipe Marker Co.
9. LEM Products Inc.

10. Marking Services, Inc.
11. Seton Identification Products; a Brady Corporation company.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

C. Self-Adhesive Pipe Labels: Printed high-gloss, flexible vinyl with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 DUCT LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.
6. Emedco.
7. Kolbi Pipe Marker Co.
8. LEM Products Inc.
9. Marking Services, Inc.
10. Seton Identification Products; a Brady Corporation company.

B. Material: Pressure-sensitive vinyl with permanent adhesive.

C. Letter Color: Black.

D. Background Color: Yellow.

E. Minimum Temperature: 50 deg F.

F. Maximum Temperature: 180 deg F.

G. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

H. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.5 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Actioncraft Products, Inc; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Brimar Industries, Inc.
4. Carlton Industries, LP.
5. Champion America.
6. Craftmark Pipe Markers.
7. Emedco.
8. Kolbi Pipe Marker Co.
9. LEM Products Inc.
10. Marking Services, Inc.
11. Seton Identification Products; a Brady Corporation company.

B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch; stainless steel, 0.025-inch; aluminum, 0.032-inch; or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain, beaded chain, or S-hook.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Champion America.
4. Craftmark Pipe Markers.
5. Emedco.
6. Kolbi Pipe Marker Co.
7. LEM Products Inc.
8. Marking Services, Inc.
9. Seton Identification Products; a Brady Corporation company.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:

1. Chilled-Water Piping: White letters on a safety-green background.
2. Condenser-Water Piping: White letters on a safety-green background.
3. Heating Water Piping: White letters on a safety-green background.
4. Refrigerant Piping: Black letters on a safety-yellow.

3.5 DUCT LABEL INSTALLATION

A. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Chilled Water: 1-1/2 inches, round.
b. Refrigerant: 1-1/2 inches, round.
c. Hot Water: 1-1/2 inches, round.
d. Gas: 1-1/2 inches, round.

2. Valve-Tag Colors:

a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
b. Flammable Fluids: Black letters on a safety-yellow background.
c. Combustible Fluids: White letters on a safety-brown background.
d. Potable and Other Water: White letters on a safety-green background.
e. Compressed Air: White letters on a safety-blue background.
f. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED SECTIONS

A. Section 232116 – Hydronic Specialties
B. Section 232123 – Hydronic Pumps
C. Section 233423 – HVAC Power Ventilators
D. Section 235216 – Condensing Boilers
E. Section 237223.29 – Packaged, Outdoor, Fixed Plate Energy Recovery Units
F. Section 237416 – Packaged Rooftop Air-Conditioning Units
G. Section 238126 – Split-System Air-Conditioners
H. Section 238223 – Unit Ventilators
I. Section 238239.13 – Cabinet Unit Heaters
J. Section 238323 – Radiant-Heating Electric Panels

1.3 REFERENCES

A. AABC – Associated Air Balance Council, National Standards for Field Measurement and Instrumentation, Total System Balance.
B. ASHRAE – 1984 Systems Handbook: Chapter 37, Testing, Adjusting and Balancing.
C. NEBB - National Environmental Balancing Bureau. Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports

1. Title page:

    a. Company name
    b. Company address
    c. Company telephone number
    d. Project name
    e. Project location
    f. Project Engineer
    g. Project Contractor

2. Return Air/Outside Air Data:

    a. Identification/location
    b. Design air flow
    c. Actual air flow
    d. Design return air flow
    e. Actual return air flow
    f. Design outside air flow
    g. Actual outside air flow
    h. Return air temperature
    i. Outside air temperature

3. Electric Motors:

    a. Manufacturer
    b. HP/BHP
    c. Phase, voltage, amperage; nameplate, actual, no load.
    d. RPM
    e. Service factor
    f. Starter size, rating, heater elements

4. Pump Data:

    a. Identification/number
    b. Manufacturer
    c. Size/model
    d. Impeller
    e. Service
    f. Design flow rate, pressure drop, BHP
    g. Actual flow rate, pressure drop, BHP
    h. Discharge pressure

i. Suction pressure
j. Total operating head pressure
k. Shut off, discharge and suction pressures
l. Shut off, total head pressure

5. Heating and Cooling Coil Data (Water):

a. Identification number
b. Location
c. Service
d. Manufacturer
e. Air flow, design and actual
f. Water flow, design and actual
g. Water pressure drop, design and actual
h. Entering water temperature, design and actual
i. Leaving water temperature, design and actual
j. Entering air temperature, design and actual
k. Leaving air temperature, design and actual
l. Air pressure drop, design and actual

6. Air Moving Equipment:

a. Location
b. Manufacturer
c. Model
d. Air flow, specified and actual
e. Return air flow, specified and actual
f. Outside air flow, specified and actual
g. Total static pressure (total external), specified and actual.
h. Inlet pressure
i. Discharge pressure
j. Fan RPM
k. Total static pressure and measured air flow in coil bypass mode
l. Total static pressure and measured air flow in coil face operation

7. Exhaust Fan Data:

a. Location
b. Manufacturer
c. Model
d. Air flow, specified and actual
e. Total static pressure (total external), specified and actual
f. Inlet pressure
g. Discharge pressure
h. Fan RPM

8. Air Distribution Test Sheet:

a. Air terminal number
b. Room number/location
c. Terminal type
d. Terminal size
e. Area factor
f. Design velocity
g. Design air flow
h. Test (final) velocity

i. Test (final) air flow
j. Percent of design air flow

9. Duct Traverse:

a. System zone/branch
b. Duct size
c. Area
d. Design velocity
e. Design air flow
f. Test velocity
g. Test air flow
h. Duct static pressure
i. Air temperature
j. Air correction factor

10. Duct Leak Test

a. Description of ductwork under test
b. Duct design operating pressure
c. Duct design test static pressure
d. Duct capacity, air flow
e. Maximum allowable duct leakage shall be 5 percent of the system capacity
f. Test apparatus

1) Blower
2) Orifice, tube size
3) Orifice size
4) Calibrated

g. Test static pressure
h. Test orifice differential pressure
i. Leakage

G. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 PROJECT RECORD DOCUMENTS

A. A final test and balance report shall include information and data to provide an accurate quantitative record of system information, measurements, and final settings.

B. Reports shall include notes and comments as appropriate to provide the reviewer with additional details that include test procedure, system operation, and results.

C. Reports shall meet all the requirements of NEBB Procedural Standards Sections 5 and 6.

1.7 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.

B. TAB Specialists Qualifications: Certified by NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB as a TAB technician.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.8 TAB RESPONSIBILITIES

A. Follow the NEBB Procedural Standards latest edition when performing the TAB work. While some procedures are described within this section, the NEBB Procedural Standards are more comprehensive and shall be followed when specific system procedures are not detailed herein, or where NEBB procedures may differ from this specification section.

B. Communicate through the proper channels any design, installation, or functional concerns that prevent the TAB work from being completed in accordance with current NEBB Procedural Standards and the design specifications.

C. Perform the TAB for all mechanical and plumbing systems specified and indicated in the construction documents.

D. Work with the systems installing contractors and controls contractor when necessary to establish system pressure settings

E. When required, perform the specified commissioning support requirements.

F. Publish a certified TAB report.

1.9 SEQUENCING AND SCHEDULING

A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

B. All mechanical systems shall be tested, balanced, and operated to demonstrate to the Owner or his representative that the installation and performance of these systems conform to the requirements of the plans and specifications.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Before commencing work, verify that systems are complete and operable. Ensure the following:

1. Verify the construction team responsibilities for system installation and start-up are complete.
2. The equipment is operable and in a safe and normal condition.
3. Temperature control systems are installed complete and operable.
4. Proper thermal overload protection is in place for electrical equipment.
5. Correct fan rotation.
6. Coil fins have been cleaned and combed.
7. Hydronic systems have been flushed, filled and vented.
8. Correct pump rotation.
9. Proper strainer baskets are clean and in place.
10. Service and balance valves are open or preset as required, and all automatic temperature control valves are in a normal or desired position.
11. Fire, smoke, and volume dampers are in place and proper position.

G. Report any defects or deficiencies noted during performance of services to Architect/Engineer.

H. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.

I. If, for design reasons, systems cannot be properly balanced, report as soon as observed.

J. Beginning of work means acceptance of existing conditions.

3.2 PREPERATION AND SCOPE

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing if requested.

B. Test and Balancing Contractor shall thoroughly review and fully understand the intent and expected results of the mechanical systems described in these construction documents and shall recommend to the engineer any additional balancing devices as required to accomplish the work of testing, adjusting and balancing the systems, and achieving system performances indicated.

C. Work with the mechanical, controls and other applicable contractors when necessary to engage their services in operating HVAC systems or altering settings that may require the services of the installation contractor.

D. At the end of each testing and adjustment session, leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring all devices to specified settings.

E. Because it is unlikely all mechanical systems are performing as required per the construction documents at start-up, the work of Testing, Adjusting and Balancing shall be completed and reported in “a minimum of” two separate visits. A minimum of two visits are intentionally required with time allotted between the two to resolve all deficiencies found in the testing portion of the work.

3.3 INSTALLATION TOLERANCES

A. Adjust hydronic systems to plus or minus 10% of design conditions indicated.

B. Adjust air systems to plus or minus 5% of the design conditions indicated.

C. Adjust domestic hot water recirculation systems to 5% of the flows indicated.

3.4 TESTING, ADJUSTING AND PRELIMINARY BALANCING

A. The purpose of “testing” is to provide preliminary adjustments, and record preliminary settings of all damper positions, balancing valve positions, motor speeds, VAV box low and high volumes, etc.

B. Recorded data shall represent actual measured or observed condition.

C. Submit the preliminary test results to the Contractors responsible for the work as well as Engineer, noting deficiencies that were observed and possible causes for the deficiencies.

D. Correspond with the contractor(s) and engineer as requested to assist in providing resolution to the problems and deficiencies noted in the preliminary findings.

E. The TAB Contractor shall cooperate in facilitating the successful completion and operation of the HVAC equipment, controls, and other items specified within Divisions 22 and 23.

3.5 FINAL ADJUSTING AND BALANCING

A. After all corrections and changes have been made in the operation and performance of the HVAC systems to correct any deficiencies found during preliminary testing, provide final visit(s) as necessary to adjust, balance and record the final performance and settings of all mechanical or plumbing systems provided or altered under this project.

B. Record all final data in the same report form as the preliminary data and provide representation of actual measured or observed conditions.

C. Upon completion of the TAB work, permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored.

D. After final adjustment, take measurements to verify final settings has not altered system balancing, or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in balancing report. Recheck points or areas as selected and witnessed by the Engineer/Owner.

G. The specified TAB project is complete when all HVAC systems and components are tested and balanced within specified tolerances.

H. When reasonable efforts have been taken to achieve requirements but system efficiencies still exist, the TAB contractor shall notify the engineer and other appropriate project personnel of system deficiencies that prevent balancing within tolerances. This notification shall be completed prior to the final report being submitted, and also noted in the project summary within the final TAB report.

3.6 GENERAL AIR SYSTEM PROCEDURES

A. Confirm the correct air filters are installed. Provide temporary filter blockage of any air handling unit, energy recovery unit, rooftop units, or other air handling system used to provide building outside air ventilation to simulate 0.15 in. w.c. partially loaded filters.

B. Check all barometric dampers for free operation. If dampers are equipped with adjustable weights, they shall be set to maintain the specified building static pressure. All exhaust systems shall be balanced before adjusting barometric relief dampers.

C. Verify that all manual branch and outlet volume dampers are locked 100% open.

D. Measure the motor operating voltage and amperage. Confirm that voltage and amperage match the motor rating.

E. Check for unusual noises that could indicate mechanical malfunction or system application issues.

F. Measure fan RPM and compare to design RPM.

G. Measure temperature conditions across outside air, return air, and exhaust/relief dampers to check leakage.

3.7 GENERAL HYDRONIC SYSTEM PROCEDURES

A. Verify that all automatically controlled devices in the piping or duct systems will not adversely affect the balancing procedures.

B. With the pumps off, observe and record system static pressure at the pumps.

C. Place the system into operation, check that all air has been vented from the piping systems and allow flow conditions to stabilize.

D. Verify that the system compression tanks, and automatic water fill valve are operating, and are set properly.

E. Record the operating voltage and amperage of the pumps and compare these with the nameplate ratings and thermal overload heater ratings.

F. Verify the RPM speed of each pump.

G. Where flow meters or calibrated balancing valves are installed, which would allow the flow rate of the pump circuits to be measured, perform the necessary work and record the data.

H. Measure the shut-off head of the operating pump by slowly closing an isolation valve or balancing valve in the pumps discharge piping. Record the discharge and suction pressures at the pump pressure gauge and determine the shut-off head. ***Note: do not fully close any valves on the suction side of any pump, nor close any valves on the discharge side of a positive displacement pump as severe damage will occur.***

I. Using shut-off head, determine and verify each pump's impeller size and operating curve. Compare this data with the submittal data curves. Open the discharge balancing valve slowly to the fully open position; record the discharge pressure, suction pressure and determine total operating head.

J. Using total operating head, read the pump water flow from the established and corrected pump curve. Verify the pump curve data with data from calibrated balancing valves or flow meters where available.

K. Set measured total head using the pump VFD or balancing valve when no VFD exists so that water flow is approximately 110% of design.

L. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates at all hydronic heating components for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

M. An initial recording of water flow distribution throughout the system shall be made without making any adjustments. Take a complete set of pressure drop measurements through all equipment and compare to submittal data. Check low flow circuits for air and vent if present. Retake readings as necessary.

N. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

O. Effect system balance with automatic control valves fully open to heat transfer elements.

P. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

Q. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

R. After all final adjustments have been completed, perform a final check of the pressures, and the flow of all pumps and equipment. RE-measure the voltage and amperage of pump motors.

S. When VFD pumping systems use system pressure to reset pump speeds, assist the controls contractor in determining and setting the final system pressure setpoint(s) to satisfy the maximum heating condition with all heating water valves fully open.

T. After all TAB work has been completed, set all memory stops and mark or score all balancing devices at final set points.

3.8 VARIABLE FLOW HYDRONIC SYSTEMS

A. TAB procedures for a variable flow system are similar to those for constant flow systems with the added mechanism(s) that exists to vary flow in response to demand. Variable flow systems shall be balanced under simulated full-load system conditions.

B. If necessary to simulate a full-load condition because of system diversity, temporary isolate portions of the system piping and terminals. Upon completion of the balancing procedures with a portion of the system isolated, the isolated units shall be opened and an equal capacity of units closed.

C. Conduct the basic pump testing and flow procedures as outlined previously and by NEBB Procedural Standards. If the pump is controlled by a VFD, verify the pump is operating at its rated speed. Caution shall be used when conducting the required pump “wide open test” on a system with diversity. Insure that an overload condition cannot be reached.

D. Slow the VFD down to achieve design flow while keeping the pump discharge balancing valve wide open.

E. The system operating pressure should always be adjusted to the minimum value necessary to meet the design conditions. Work with the controls contractor to set the value and record.

3.9 DUCTED CONSTANT VOLUME SUPPLY AHU AIR BALANCING

A. Upon completion and verification of examination, preparation and general requirements noted above, perform the following TAB procedures.

B. AHU’s to be set with a fixed outside air (and return/relief/exhaust) damper during occupied periods shall be set to an appropriate position as a starting point to the air balancing.

C. Air handling units with a cooling coil shall have outside air set to a position estimated to equal design minimum OA flow. Air handling units using with no mechanical cooling and specified to use 100% outside air for economizer cooling shall have OA damper(s) positioned 100% open and return dampers 100% closed.

D. For fan total static pressure, measure suction and discharge static pressure at the inlet and outlet of the fan. To verify external static pressure, measure the suction and discharge static

pressure at the return duct and discharge duct. The suction static can be measured immediately adjacent to the unit. The discharge static should be measured at a point 3 to 5 duct diameters downstream of the fan discharge and upstream of any elbow or turning vanes.

E. Measure the AHU total air volume by the most accurate method available as the discretion of and judgement of the technician. Adjust the fan airflow as necessary to meet design requirements.

F. Adjust air handling units to provide required design supply and return air flow at inlets and outlets.

G. After supply, return, and exhaust systems are properly balanced, the supply (and return) fan capacities should be rechecked with 100% outside air when units are specified to operate in economizer mode for ventilation.

H. At the end of all inlet and outlet balancing, re-adjust the AHU minimum outside air ventilation rate as necessary.

I. Constant volume return air systems shall be balanced using the same principles and guidelines as for constant volume supply air systems.

3.10 CONSTANT VOLUME RETURN AIR BALANCING

A. Constant volume ducted return air systems shall be balanced using the same principles and guidelines as for constant volume supply air systems.

B. Return diffusers open to ceiling plenums cannot be balanced, however airflows should be recorded and total return air summarized by fan system.

3.11 CONSTANT VOLUME EXHAUST AIR SYSTEMS

A. Constant volume exhaust air systems shall be balanced using the same principles and guidelines as for constant volume supply systems. Follow standard procedures and incorporate any modifications necessary to accomplish the specified requirements.

3.12 VARIABLE AIR VOLUME AHU WITH STATIC PRESSURE RESET CONTROL

A. VAV systems utilizing static pressure reset control using trim and respond logic shall require the balancing contractor to work with the controls contractor when tuning the reset control to prevent cyclic instability.

B. Final maximum setpoint shall be determined by the balancing contractor to satisfy the worst-case zone at maximum design condition.

3.13 VARIABLE AIR VOLUME TERMINAL UNITS – PRESSURE INDEPENDENT

A. Set the volume controller to design maximum airflow.

B. Test the total airflow delivered by the outlets downstream of the VAV box.

C. Calibrate the controller to the measured airflow.

D. Balance the airflow from each outlet.

E. Set the volume controller to the design minimum airflow.

F. Balance modulating heating water valve flow of reheat coil per hydronic balancing requirements.

3.14 VARIABLE AIR VOLUME RETURN FANS

A. An open loop, control shall use an adjustable span and start point on the supply air and return air fan controls to sequence the return fan operation and speed with supply fan. Resistance to air flow in the return air system may not vary in direct proportion to resistance in the supply air system zones as supply air varies. While only a sampling, the TAB contractor shall set the return fan offset (if any) at maximum supply air flow to the VAV boxes and then record the variation in CFM air flow between the supply and air flow at minimum VAV box airflow settings.

B. A closed loop control

3.15 CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.16 BOILERS

A. Measure and record entering- and leaving-water temperatures.

B. Measure and record water flow.

C. Record relief valve pressure rating.

3.17 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

B. Entering- and leaving-water temperature.

C. Water flow rate.

D. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.

E. Dry-bulb temperature of entering and leaving air.

F. Wet-bulb temperature of entering and leaving air for cooling coils.

G. Airflow.

H. Measure, adjust, and record the following data for each electric heating coil:

I. Nameplate data.

J. Airflow.

K. Entering- and leaving-air temperature at full load.

L. Voltage and amperage input of each phase at full load.

M. Calculated kilowatt at full load.

N. Fuse or circuit-breaker rating for overload protection.

O. Measure, adjust, and record the following data for each steam coil:

P. Dry-bulb temperature of entering and leaving air.

Q. Airflow.

R. Measure, adjust, and record the following data for each refrigerant coil:

S. Dry-bulb temperature of entering and leaving air.

T. Wet-bulb temperature of entering and leaving air.

U. Airflow.

3.18 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, concealed return located in unconditioned space.
3. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
4. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
5. Outdoor, exposed supply and return.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230500 "Common Work Results for HVAC."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed, LLC.

1) SoftTouch™ Duct Wrap

b. Johns Manville; a Berkshire Hathaway company.

1) Microlite® FSK

c. Knauf Insulation, Inc.

1) Performance +™ Duct Wrap with ECOSE®

d. Manson Insulation Inc.

1) Alley Wrap® B

e. Owens Corning.

1) SoftR® Duct Wrap FRK

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ or FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed, LLC.

1) CertaPRO®

b. Johns Manville; a Berkshire Hathaway company.

1) Spin-Glas® 800 series

c. Knauf Insulation, Inc.

1) Earthwool®

d. Manson Insulation Inc.

1) AK Board®

e. Owens Corning.

1) Fiberglas™ 703 series board

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

2.3 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges – Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.
d. Mon-Eco Industries.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.

B. Self-Adhesive Outdoor Jacket: Impact- and tear-resistant, pre-fabricated, self-adhering, sheet-type protective membrane serving as a vapor barrier and waterproofing membrane for

installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with stucco-embossed UV-resistant aluminum-foil facing. Roll stock ready for field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M

        1) VentureClad™ 1579CWE-EMJ

    b. MFM Building Products Corp

        1) FlexClad® 250

    c. Polyguard Products, Inc.

        1) Alumaguard®

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M.
    b. Avery Dennison Corporation, Specialty Tapes Division.
    c. Ideal Tape Co., an American Biltrite Company.
    d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M.
    b. Avery Dennison Corporation, Specialty Tapes Division.
    c. Ideal Tape Co., an American Biltrite Company.
    d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.

5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. 3M.
   b. Avery Dennison Corporation, Specialty Tapes Division.
   c. Ideal Tape Co., an American Biltrite Company.
   d. Knauf Insulation.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.8 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Johns Manville; a Berkshire Hathaway company.
   b. RPR Products, Inc.

2. Stainless Steel: ASTM A167 or ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) AGM Industries, Inc.
      2) Gemco.
      3) Midwest Fasteners, Inc.
      4) Nelson Stud Welding.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) CL WARD & Family Inc.
3) Gemco.
4) Midwest Fasteners, Inc.
5) Nelson Stud Welding.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Midwest Fasteners, Inc.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030-inch-thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low-carbon steel; aluminum; or stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Gemco.
2) Midwest Fasteners, Inc.

b. Baseplate: Perforated, nylon sheet, 0.030-inch-thick by 1-1/2 inches in diameter.
c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Midwest Fasteners, Inc.

b. Baseplate: Galvanized carbon-steel sheet, 0.030-inch-thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low-carbon steel; aluminum; or stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel, aluminum, or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Midwest Fasteners, Inc.
4) Nelson Stud Welding.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Gemco.
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.080-inch nickel-copper alloy; 0.062-inch soft-annealed, stainless steel; or 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.
b. Johsn Manville; a Berkshire Hathaway company.
c. RPR Products, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof

sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

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

B. Tests and Inspections:

1. Inspect ductwork by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, concealed return located in unconditioned space.
3. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
4. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
5. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. If more than one material is listed, selection from materials listed is Contractor's option.

B. Concealed, round, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.

C. Concealed, round, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.

D. Concealed, round, exhaust-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.

E. Concealed, rectangular, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.
2. Mineral-Fiber Board: 1-1/2 inches thick and 3.0 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.

F. Concealed, rectangular, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.
2. Mineral-Fiber Board: 1-1/2 inches thick and 3.0 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.

G. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.
2. Mineral-Fiber Board: 1-1/2 inches thick and 3.0 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.

H. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

I. Concealed, supply-air plenum insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.
2. Mineral-Fiber Board: 1-1/2 inches thick and 3.0 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.

J. Concealed, return-air plenum insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.
2. Mineral-Fiber Board: 1-1/2 inches thick and 3.0 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.

K. Concealed, exhaust-air plenum insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.
2. Mineral-Fiber Board: 1-1/2 inches thick and 3.0 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 6.

3.11 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below.

B. Exposed, rectangular, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Board: 3 inches thick and 3.0 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 12.

C. Exposed, rectangular, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Board: 3 inches thick and 3.0 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 12.

D. Exposed, supply-air plenum insulation shall be one of the following:

1. Mineral-Fiber Board: 3 inches thick and 3.0 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 12.

E. Exposed, return-air plenum insulation shall be one of the following:

1. Mineral-Fiber Board: 3 inches thick and 3.0 lb/cu.ft. density or of a thickness and density to achieve a minimum, installed, total R-value of 12.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. Self-adhesive aluminum, stucco embossed: Minimum 16 mils (0.016 inches/0.40 mm) thick.

C. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:

1. Self-adhesive aluminum, stucco embossed: Minimum 16 mils (0.016 inches/0.40 mm) thick.

END OF SECTION

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulation for HVAC piping systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230500 "Common Work Results for HVAC."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General" and "Indoor Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials, Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA, Inc.

1) Aeroflex EPDM™ (Tubular, unslit)

b. Armacell LLC.

1) AP/ArmaFlex (For thickness up to and including 1 inch)
2) AP/ArmaFlex FS (For thickness greater than 1 inch)

c. K-Flex USA.

1) Insul-Tube (Tubular, unslit)
2) Insul-Lock DS (Pre-slit with overlap seal)

E. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

1) Micro-Lok® HP

b. Knauf Insulation, Inc.

1) Earthwool® 1000° Pipe Insulation

c. Manson Insulation Inc.

1) Alley-K®

d. Owens Corning.

1) SSL II® with ASJ Max Fiberglas™

2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ-SSL.
3. 850 deg F.
4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ramco Insulation, Inc.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ramco Insulation, Inc.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ramco Insulation, Inc.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

2.4 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

2.5 LAGGING ADHESIVES

A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

2.6 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M.
    b. Avery Dennison Corporation, Specialty Tapes Division.
    c. Ideal Tape Co., an American Biltrite Company.
    d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M.
    b. Avery Dennison Corporation, Specialty Tapes Division.
    c. Ideal Tape Co., an American Biltrite Company.
    d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.

7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M.
b. Ideal Tape Co., an American Biltrite Company.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M.
b. Avery Dennison Corporation, Specialty Tapes Division.
c. Ideal Tape Co., an American Biltrite Company.
d. Knauf Insulation.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. RPR Products, Inc.

2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015-inch-thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch-thick, 1/2 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel, with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy; 0.062-inch soft-annealed, stainless steel; 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. C & F Wire.
    b. Johns Manville; a Berkshire Hathaway company.
    c. RPR Products, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Mix insulating cements with clean potable water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.4 PENETRATIONS

A. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD QUALITY CONTROL

A. Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections: Inspect pipe, fittings, strainers, and valves by removing field-applied jacket and insulation in layers in reverse order of their installation.

D. All insulation applications will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Underground piping.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inches thick.

1. NPS 1-1/2 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. NPS 7/8 and Smaller: Insulation shall be the following:

a. Flexible Elastomeric: 1/2 inch thick.

2. NPS 1and Larger: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

C. Refrigerant Liquid Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. BAS for monitoring and controlling of HVAC systems.
2. Delivery of selected control devices to equipment and systems manufacturers for factory installation and to HVAC systems installers for field installation.

B. Related Requirements:

1. Section 232123 Hydronic Pumps;
2. Section 233423 HVAC Power Ventilators;
3. Section 235216 Condensing Boilers;
4. Section 237223.29 Packaged, Outdoor, Fixed Plate Energy Recovery Units;
5. Section 237416 Packaged Rooftop Air-Conditioning Units
6. Section 238126 Split-System Air-Conditioners;
7. Section 238223 Unit Ventilators;
8. Section 238239.13 Cabinet Unit Heaters;
9. Section 238323 Radiant-Heating Electric Panels;
10. Control Diagrams and Sequence of Operations shown on the Construction Drawings;
11. Division 26 – Electrical for all low voltage and line voltage wiring, raceways, conduit, boxes, and labeling.

1.3 DEFINITIONS

A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.
B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.
C. BACnet Specific Definitions:

1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.
2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.

D. BAS: Building Automation System for primarily controlling HVAC systems and components, but may incorporate control of other building functions such as lighting, security cameras and door locks, etc.
E. Binary: Two-state signal where a high signal level represents ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.
F. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.
G. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.
H. COV: Changes of value.
I. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.
J. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.
K. DOCSIS: Data-Over Cable Service Interface Specifications.
L. E/P: Voltage to pneumatic.
M. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.
N. HLC: Heavy load conditions.
O. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.
P. I/P: Current to pneumatic.
Q. LAN: Local area network.
R. LNS: LonWorks Network Services.
S. LON Specific Definitions:

1. FTT-10: Echelon Transmitter-Free Topology Transceiver.
2. LonMark: Association comprising suppliers and installers of LonTalk products. Association provides guidelines for implementing LonTalk protocol to ensure interoperability through a standard or consistent implementation.
3. LonTalk: An open standard protocol developed by the Echelon Corporation that uses a "Neuron Chip" for communication. LonTalk is a register trademark of Echelon.
4. LonWorks: Network technology developed by Echelon.
5. Node: Device that communicates using CEA-709.1-C protocol and that is connected to a CEA-709.1-C network.
6. Node Address: The logical address of a node on the network, consisting of a Domain number, Subnet number, and Node number. "Node number" portion of an address is a number assigned to device during installation, is unique within a subnet, and is not a factory-set unique Node ID.
7. Node ID: A unique 48-bit identifier assigned at factory to each CEA-709.1-C device. Sometimes called a "Neuron ID."
8. Program ID: An identifier (number) stored in a device (usually EEPROM) that identifies node manufacturer, functionality of device (application and sequence), transceiver used, and intended device usage.

9. Standard Configuration Property Type (SCPT): Pronounced "skip-it." A standard format type maintained by LonMark International for configuration properties.
10. Standard Network Variable Type (SNVT): Pronounced "snivet." A standard format type maintained by LonMark used to define data information transmitted and received by individual nodes. "SNVT" is used in two ways. It is an acronym for "Standard Network Variable Type" and is often used to indicate a network variable itself (i.e., it can mean "a network variable of a standard network variable type").
11. Subnet: Consists of a logical grouping of up to 127 nodes, where logical grouping is defined by node addressing. Each subnet is assigned a number, which is unique within a Domain. See "Node Address."
12. TP/FT-10: Free Topology Twisted Pair network defined by CEA-709.3 and is most common media type for a CEA-709.1-C control network.
13. TP/XF-1250: High-speed, 1.25-Mbps, twisted-pair, doubly terminated bus network defined by "LonMark Interoperability Guidelines" typically used only to connect multiple TP/FT-10 networks.
14. User-Defined Configuration Property Type (UCPT): Pronounced "U-Keep-It." A Configuration Property format type that is defined by device manufacturer.
15. User-Defined Network Variable Type (UNVT): Network variable format defined by device manufacturer. UNVTs create non-standard communications that other vendors' devices may not correctly interpret and may negatively impact system operation. UNVTs are not allowed.

T. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
U. Mobile Device: A data-enabled phone or tablet computer capable of connecting to a cellular data network and running a native control application or accessing a web interface.
V. Modbus TCP/IP: An open protocol for exchange of process data.
W. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.
X. MTBF: Mean time between failures.
Y. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.
Z. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.
AA. Peer to Peer: Networking architecture that treats all network stations as equal partners.
BB. POT: Portable operator's terminal.
CC. PUE: Performance usage effectiveness.
DD. RAM: Random access memory.
EE. RF: Radio frequency.
FF. Router: Device connecting two or more networks at network layer.
GG. Server: Computer used to maintain system configuration, historical and programming database.
HH. TCP/IP: Transport control protocol/Internet protocol.
II. UPS: Uninterruptible power supply.
JJ. USB: Universal Serial Bus.
KK. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.
LL. VAV: Variable air volume.
MM. WLED: White light emitting diode.

1.4 PREINSTALLATION MEETING

A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

A. Product Data: For each type of product include the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation and maintenance instructions including factors effecting performance.
5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.

    a. Workstations.
    b. Servers.
    c. Gateways.
    d. Routers.
    e. Protocol analyzers.
    f. DDC controllers.
    g. Enclosures.
    h. Electrical power devices.
    i. Accessories.
    j. Instruments.
    k. Control dampers and actuators.
    l. Control valves and actuators.

6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

B. Software Submittal:

1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
2. Description and technical data of all software provided, and cross-referenced to products in which software will be installed.
3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
4. Include a flow diagram and an outline of each subroutine that indicates each program variable name and units of measure.
5. Listing and description of each engineering equation used with reference source.
6. Listing and description of each constant used in engineering equations and a reference source to prove origin of each constant.
7. Description of operator interface to alphanumeric and graphic programming.
8. Description of each network communication protocol.

9. Description of system database, including all data included in database, database capacity and limitations to expand database.
10. Description of each application program and device drivers to be generated, including specific information on data acquisition and control strategies showing their relationship to system timing, speed, processing burden and system throughout.
11. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

C. Shop Drawings:

1. General Requirements:

    a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
    b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.

2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Plan Drawings indicating the following:

    a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
    b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
    c. Each desktop workstation, server, gateway, router, BAS controller, control panel instrument connecting to BAS controller, and damper and valve connecting to BAS controller, if included in Project.
    d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
    e. Network communication cable and raceway routing.
    f. Proposed routing of wiring, cabling, conduit, and tubing, coordinated with building services for review before installation.

4. Schematic drawings for each controlled HVAC system indicating the following:

    a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
    b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
    c. A graphic showing location of control I/O in proper relationship to HVAC system.
    d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
    e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
    f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to BAS controllers.
    g. Narrative sequence of operation.

h. Graphic sequence of operation, showing all inputs and output logical blocks.

5. Control panel drawings indicating the following:

a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.
c. Front, rear, and side elevations and nameplate legend.
d. Unique drawing for each panel.

6. BAS system network riser diagram indicating the following:

a. Each device connected to network with unique identification for each.
b. Interconnection of each different network in DDC system.
c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or optical fiber cable type. Indicate raceway type and size for each.
d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.

7. BAS system electrical power riser diagram indicating the following:

a. Each point of connection to field power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
c. Each product requiring power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
d. Power wiring type and size, race type, and size for each.

8. Monitoring and control signal diagrams indicating the following:

a. Control signal cable and wiring between controllers and I/O.
b. Point-to-point schematic wiring diagrams for each product.
c. Control signal tubing to sensors, switches and transmitters.
d. Process signal tubing to sensors, switches and transmitters.

D. System Description:

1. Full description of BAS architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
3. System and product operation under each potential failure condition
4. Complete bibliography of documentation and media to be delivered to Owner.
5. Description of testing plans and procedures.
6. Description of Owner training.

E. Delegated-Design Submittal: For BAS system products and installation indicated as being delegated.

1. Supporting documentation showing BAS system design complies with performance requirements indicated, including calculations and other documentation necessary to prove compliance.
2. Schedule control dampers and actuators.
3. Schedule for control valves and actuators.
4. Schedule for flow instruments.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

a. Product installation location shown in relationship to room, duct, pipe and equipment.
b. Structural members to which products will be attached.
c. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices and other installed devices.
d. Size and location of wall access panels for products installed behind walls and requiring access.

2. Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

a. Size and location of access panels for products installed above inaccessible ceiling assemblies and requiring access.

PART 2 - PRODUCTS

2.1 BAS SYSTEM MANUFACTURERS

A. The existing building automation system utilizes ABB Aspect with Peer-To-Peer Protocol and Bacnet programmable controllers.
B. The current controls contractor is Tri City Controls out of Frankenmuth, MI.
C. Controls installers who can integrate existing and new controls through a single I/P address and meet the requirements of these construction documents are approved.

2.2 BAS SYSTEM DESCRIPTION

A. Microprocessor-based monitoring and control including analog/digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices to achieve a set of predefined conditions.

1. BAS system shall consist of a high-speed peer-to-peer network of distributed BAS controllers, other network devices, operator interfaces, and software.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and

application.

2.3 WEB ACCESS

A. BAS system shall be Web based.

1. Web-Based Access to BAS:

a. BAS software shall be designed around open standards of Web technology. BAS server shall be accessed using a Web browser over BAS network, using Owner's LAN, and remotely over Internet through Owner's LAN. Controls contractor shall be responsible for working with the Owners IT personnel to coordinate the Internet access.
b. Provide operators complete access to BAS system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
c. Web access shall be password protected.

2.4 PERFORMANCE REQUIREMENTS

A. BAS shall satisfy requirements indicated.

1. System Performance Objectives:

a. BAS shall manage HVAC systems.
b. BAS control shall operate HVAC systems to achieve optimum operating costs while using least possible energy and maintaining specified performance.
c. BAS shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.
d. BAS shall operate while unattended by an operator and through operator interaction.
e. BAS shall record trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.

B. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Network Bandwidth: Design each network of BAS to include at least 30 percent available spare bandwidth with BAS operating under normal and heavy load conditions indicated. Calculate bandwidth usage, and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.

D. BAS Data Storage:

1. Include capability to archive not less than 24 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
2. Local Storage:

a. Provide server with data storage indicated. Server(s) shall use IT industry standard database platforms and be capable of functions described in "DDC Data Access" Paragraph.

3. Cloud Storage:

a. Provide web browser interfaces to configure, upload, download, and manage data, and service plan with storage adequate to store all data for term indicated. Cloud storage shall use IT industry standard database platforms and be capable of functions described in "BAS Data Access" Paragraph.

E. BAS Data Access:

1. When logged into the system, operator shall be able to also interact with any BAS controller connected to BAS as required for functional operation of the system.
2. System(s) shall be used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information management; for alarm annunciation; and for operator interface tasks and controls application management.

F. Environmental Conditions for Controllers, Gateways, and Routers:

1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.
2. Products shall be protected with enclosures that withstand the environment in which they will be installed. Products not available with integral enclosures that comply shall be housed in protective secondary enclosures. Installed location shall dictate the NEMA 250 enclosure requirements.

G. Environmental Conditions for Instruments and Actuators:

1. Instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and ventilated as required by instrument and application.

H. Electric Power Quality:

1. Power-Line Surges:

a. Protect susceptible BAS products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41.
b. Do not use fuses for surge protection.

2. Power Conditioning:

a. Protect susceptible BAS products connected to ac power circuits from irregularities and noise rejection.

3. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.

I. Backup Power Source:

1. HVAC systems and equipment served by a backup power source shall have associated BAS products that control such systems and equipment also served from a backup power source.

J. Continuity of Operation after Electric Power Interruption:

1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.5 SYSTEM ARCHITECTURE

A. BAS shall consist of dedicated LANs that are not shared with other building systems and tenant data and communication networks.
B. System architecture shall perform modifications without having to remove and replace existing network equipment.
C. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.
D. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.

2.6 BAS SYSTEM OPERATOR INTERFACES

A. Operator Means of System Access: Operator shall be able to access entire BAS through any of multiple means, including, but not limited to, remote connection through web access.
B. Critical Alarm Reporting:

1. Operator-selected critical alarms shall be sent by BAS to notify operator of critical alarms that require immediate attention.
2. BAS shall send alarm notification to multiple recipients that are assigned for each alarm.
3. BAS shall notify recipients by any or all means, including e-mail, text message and prerecorded phone message to mobile and landline phone numbers.

C. Simultaneous Operator Use: Capable of accommodating up to a minimum of five simultaneous operators that are accessing BAS through any one of operator interfaces indicated.

2.7 NETWORKS

A. Assure that the BAS being installed will operate and function on the network within the clients facility for connecting workstations, mobile devices, and network controllers.

2.8 DDC SYSTEM WIRELESS NETWORKS

A. Use an open industry standard technology to create a wireless mesh network to provide wireless connectivity for network devices at multiple system levels including communications from programmable application controllers and application-specific controllers to temperature sensors and from network controllers to programmable application controllers and application-specific controllers.
B. Installer shall design wireless networks to comply with DDC system performance requirements indicated. Wireless network devices shall co-exist on same network with hardwired devices.
C. Hardwired controllers shall be capable of retrofit to wireless devices with no special software.
D. A wireless coordinator shall provide a wireless interface between programmable application controllers, application-specific controllers, and network controllers.
E. Wireless System Components shall comply with the following:

1. Use direct sequence spread spectrum RF technology.
2. Operate on the 2.4-GHz ISM Band.
3. Comply with IEEE 802.15.4 for low-power, low duty-cycle RF transmitting systems.
4. FCC compliant to 47 CFR 15, Subpart B, Class A.
5. Operate as a bidirectional transceiver with sensors and routers to confirm and synchronize data transmission.
6. Capable of communication with sensors and routers up to a maximum distance of 250 feet in line of sight.
7. Include visual indicators to provide diagnostic information required for operator verification of operation.

F. Wireless Coordinators:

1. Each wireless mesh network shall use wireless coordinator(s) for initiation and formation of network.

G. Wireless Routers:

1. Each wireless mesh network shall use wireless routers with any controller to provide a wireless interface to a network controller, through a wireless coordinator.
2. Include indication for use in commissioning and troubleshooting.

H. Wireless Temperature Sensors:

1. Wireless temperature sensors shall sense and transmit room temperatures, temperature set point, room occupancy notification and low battery condition to an associated router.
2. Multiple sensors shall be able to report to a router connected to a DDC controller for averaging or high and low selection.

I. One-to-One Wireless Network Receivers:

1. One-to-one wireless receivers shall receive wireless RF signals containing temperature data from multiple wireless room temperature sensors and communicate information to programmable application controllers or application-specific controllers.

J. One-to-One Wireless Network Sensors:

1. One-to-one wireless sensors shall sense and report room temperatures to one-to-one receiver.

a. Include set point adjustment between 55 to 85 deg F.

2.9 SYSTEM SOFTWARE

A. System Software Minimum Requirements:

1. Real-time multitasking and multiuser 32- or 64-bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.
2. Operating system shall be capable of operating DOS and Microsoft Windows applications.
3. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
4. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.
5. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
6. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

B. Operator Interface Software:

1. Minimize operator training through use of English language prorating and English language point identification.
2. Minimize use of a typewriter-style keyboard through use of a pointing device similar to a mouse.
3. Operator sign-off shall be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.
4. Automatic sign-off period shall be programmable from one to 60 minutes in one-minute increments on a per operator basis.
5. Operator sign-on and sign-off activity shall be recorded and sent to printer.
6. Security Access:

a. Operator access to BAS shall be under password control.
b. An alphanumeric password shall be field assignable to each operator.
c. Operators shall be able to access BAS by entry of proper password.
d. Operator password shall be same regardless of which computer or other interface means is used.
e. Additions or changes made to passwords shall be updated automatically.

f. Each operator shall be assigned an access level to restrict access to data and functions the operator is cable of performing.
g. Software shall have at least five access levels.
h. Each menu item shall be assigned an access level so that a one-for-one correspondence between operator assigned access level(s) and menu item access level(s) is required to gain access to menu item.
i. Display menu items to operator with those capable of access highlighted. Menu and operator access level assignments shall be online programmable and under password control.

7. Data Segregation:

a. Include data segregation for control of specific data routed to a workstation, to an operator or to a specific output device, such as a printer.
b. Segregation groups shall be selectable such as "fire points," "fire points on second floor," "space temperature points," "HVAC points," and so on.
c. Points shall be assignable to multiple segregation groups. Display and output of data to printer or monitor shall occur where there is a match of operator or peripheral segregation group assignment and point segregations.
d. Alarms shall be displayed and printed at each peripheral to which segregation allows, but only those operators assigned to peripheral and having proper authorization level will be allowed to acknowledge alarms.
e. Operators and peripherals shall be assignable to multiple segregation groups and all assignments are to be online programmable and under password control.

8. Operators shall be able to perform commands including, but not limited to, the following:

a. Start or stop selected equipment.
b. Adjust set points.
c. Add, modify, and delete time programming.
d. Enable and disable process execution.
e. Lock and unlock alarm reporting for each point.
f. Enable and disable totalization for each point.
g. Enable and disable trending for each point.
h. Override control loop set points.
i. Enter temporary override schedules.
j. Define holiday schedules.
k. Change time and date.
l. Enter and modify analog alarm limits.
m. Enter and modify analog warning limits.
n. View limits.
o. Enable and disable demand limiting.
p. Enable and disable duty cycle.
q. Display logic programming for each control sequence.

9. Reporting:

a. Generated automatically and manually.
b. Sent to displays, printers and disk files.
c. Types of Reporting:

1) General listing of points.

2) List points currently in alarm.
3) List of off-line points.
4) List points currently in override status.
5) List of disabled points.
6) List points currently locked out.
7) List of items defined in a "Follow-Up" file.
8) List weekly schedules.
9) List holiday programming.
10) List of limits and dead-bands.

10. Summaries: For specific points, for a logical point group, for an operator selected group(s), or for entire system without restriction due to hardware configuration.

C. Graphic Interface Software:

1. Include a full interactive graphical selection means of accessing and displaying system data to operator. Include at least five levels with the penetration path operator assignable (for example, site, building, floor, air-handling unit, and supply temperature loop). Native language descriptors assigned to menu items are to be operator defined and modifiable under password control.
2. Include a hierarchical-linked dynamic graphic operator interface for accessing and displaying system data and commanding and modifying equipment operation. Interface shall use a pointing device with pull-down or penetrating menus, color and animation to facilitate operator understanding of system.
3. Include at least 10 levels of graphic penetration with the hierarchy operator assignable.
4. Descriptors for graphics, points, alarms and such shall be modified through operator's workstation under password control.
5. Graphic displays shall be online user definable and modifiable using the hardware and software provided.
6. Data to be displayed within a graphic shall be assignable regardless of physical hardware address, communication or point type.
7. Graphics are to be online programmable and under password control.
8. Points may be assignable to multiple graphics where necessary to facilitate operator understanding of system operation.
9. Graphics shall also contain software points.
10. Penetration within a graphic hierarchy shall display each graphic name as graphics are selected to facilitate operator understanding.
11. Back-trace feature shall permit operator to move upward in the hierarchy using a pointing device. Back trace shall show all previous penetration levels. Include operator with option of showing each graphic full screen size with back trace as horizontal header or by showing a "stack" of graphics, each with a back trace.
12. Display operator accessed data on the monitor.
13. Operator shall select further penetration using pointing device to click on a site, building, floor, area, equipment, and so on. Defined and linked graphic below that selection shall then be displayed.
14. Include operator with means to directly access graphics without going through penetration path.
15. Dynamic data shall be assignable to graphics.
16. Display points (physical and software) with dynamic data provided by BAS with appropriate text descriptors, status or value, and engineering unit.
17. Use color, rotation, or other highly visible means, to denote status and alarm states. Color shall be variable for each class of points, as chosen by operator.
18. Points shall be dynamic with operator adjustable update rates on a per point basis.

19. For operators with appropriate privilege, points shall be commanded directly from display using pointing device.

    a. For an analog command point such as set point, current conditions and limits shall be displayed and operator can position new set point using pointing device.
    b. For a digital command point such as valve position, valve shall show its current state such as open or closed and operator could select alternative position using pointing device.
    c. Keyboard equivalent shall be available for those operators with that preference.

20. Operator shall be able to split or resize viewing screen into quadrants to show one graphic on one quadrant of screen and other graphics or spreadsheet, bar chart, word processing, curve plot and other information on other quadrants on screen. This feature shall allow real-time monitoring of one part of system while displaying other parts of system or data to better facilitate overall system operation.
21. Help Features:

    a. On-line context-sensitive help utility to facilitate operator training and understanding.
    b. Bridge to further explanation of selected keywords. Document shall contain text and graphics to clarify system operation.

        1) If help feature does not have ability to bridge on keywords for more information, a complete set of user manuals shall be provided in an indexed word-processing program, which shall run concurrently with operating system software.

    c. Available for Every Menu Item:

        1) Index items for each system menu item.

22. Graphic generation software shall allow operator to add, modify, or delete system graphic displays.

    a. Include libraries of symbols depicting HVAC symbols such as fans, coils, filters, dampers, valves pumps, and electrical symbols.
    b. Graphic development package shall use a pointing device in conjunction with a drawing program to allow operator to perform the following:

        1) Define background screens.
        2) Define connecting lines and curves.
        3) Locate, orient and size descriptive text.
        4) Define and display colors for all elements.
        5) Establish correlation between symbols or text and associated system points or other displays.

D. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:

1. Site plan showing each building, and additional site elements, which are being controlled or monitored by BAS.

2. Plan for each building floor, including interstitial floors, and each roof level of each building, showing the following:

    a. Room layouts with room identification and name.
    b. Locations and identification of all monitored and controlled HVAC equipment and other equipment being monitored and controlled by BAS.
    c. Location and identification of each hardware point being controlled or monitored by BAS.

3. Control schematic for each of following, including a graphic system schematic representation with point identification, set point and dynamic value indication, and sequence of operation.
4. Graphic display for each piece of equipment connected to BAS through a data communications link. Include dynamic indication of all points associated with equipment.
5. BAS network riser diagram that shows schematic layout for entire system including all networks and all controllers.

E. Customizing Software:

1. Software to modify and tailor BAS to specific and unique requirements of equipment installed, to programs implemented and to staffing and operational practices planned.
2. Online modification of BAS configuration, program parameters, and database using menu selection and keyboard entry of data into preformatted display templates.
3. As a minimum, include the following modification capability:

    a. Operator assignment shall include designation of operator passwords, access levels, point segregation and auto sign-off.
    b. Peripheral assignment capability shall include assignment of segregation groups and operators to consoles and printers, designation of backup workstations and printers, designation of workstation header points and enabling and disabling of print-out of operator changes.
    c. System configuration and diagnostic capability shall include communications and peripheral port assignments, BAS controller assignments to network, BAS controller enable and disable, assignment of command trace to points and application programs and initiation of diagnostics.
    d. System text addition and change capability shall include English or native language descriptors for points, segregation groups and access levels and action messages for alarms, run time and trouble condition.
    e. Time and schedule change capability shall include time and date set, time and occupancy schedules, exception and holiday schedules and daylight savings time schedules.
    f. Point related change capability shall include the following:

        1) System and point enable and disable.
        2) Run-time enable and disable.
        3) Assignment of points to segregation groups, calibration tables, lockout, and run time and to a fixed I/O value.
        4) Assignment of alarm and warning limits.

    g. Application program change capability shall include the following:

        1) Enable and disable of software programs.

2) Programming changes.
3) Assignment of comfort limits, global points, time and event initiators, time and event schedules and enable and disable time and event programs.

4. Software shall allow operator to add points, or groups of points, to BAS and to link them to energy optimization and management programs. Additions and modifications shall be online programmable using operator workstation, downloaded to other network devices and entered into their databases. After verification of point additions and associated program operation, database shall be uploaded and recorded on hard drive and disk for archived record.

F. Alarm Handling Software:

1. Include alarm handling software to report all alarm conditions monitored and transmitted through BAS controllers.
2. Include first in, first out handling of alarms according to alarm priority ranking, with most critical alarms first, and with buffer storage in case of simultaneous and multiple alarms.
3. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to BAS.
4. Alarms display shall include the following:

   a. Indication of alarm condition such as "Abnormal Off," "Hi Alarm," and "Low Alarm."
   b. "Analog Value" or "Status" group and point identification with native language point descriptor such as "Space Temperature, Building 110, 2nd Floor, Room 212."
   c. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.

5. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and segregation assignments.
6. Send e-mail alarm messages to designated operators.
7. Send e-mail, page, text and voice messages to designated operators for critical alarms.
8. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.

G. Reports and Logs:

1. Include reporting software package that allows operator to select, modify, or create reports using BAS I/O point data available.
2. Each report shall be definable as to data content, format, interval and date.
3. Report data shall be sampled and stored on BAS controller, within storage limits of BAS controller, and then uploaded to archive on for historical reporting.
4. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
5. Reports and logs shall be stored on server hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.

6. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.

H. Standard Reports: Standard BAS reports shall be provided and operator shall be able to customize reports later.

1. All I/O: With current status and values.
2. Alarm: All current alarms, except those in alarm lockout.
3. Disabled I/O: All I/O points that are disabled.
4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
6. Logs:

a. Alarm history.
b. System messages.
c. System events.
d. Trends.

I. Custom Reports: Operator shall be able to easily define any system data into a daily, weekly, monthly, or annual report. Reports shall be time and date stamped and shall contain a report title.

J. Programming Software:

1. Include programming software to execute sequences of operation indicated.
2. Include programming routines in simple and easy to follow logic with detailed text comments describing what the logic does and how it corresponds to sequence of operation.
3. Programming software shall be:

a. Graphic Based: Programming shall use a library of function blocks made from preprogrammed code designed for BAS control systems.

1) Function blocks shall be assembled with interconnection lines that represent to control sequence in a flowchart.
2) Programming tools shall be viewable in real time to show present values and logical results of each function block.

b. Menu Based: Programming shall be done by entering parameters, definitions, conditions, requirements and constraints.
c. Line by Line and Text Based: Programming shall declare variable types such as local, global, real, integer, and so on, at the beginning of the program. Use descriptive comments frequently to describe programming code.

4. Include means for detecting programming errors and testing software control strategies with a simulation tool before implementing in actual control. Simulation tool may be inherent with programming software or as a separate product.

K. Database Management Software:

1. Where a separate SQL database is used for information storage, BAS shall include database management software that separates database monitoring and managing functions by supporting multiple separate windows.

2. Database secure access shall be accomplished using standard SQL authentication including ability to access data for use outside of BAS applications.
3. Database management function shall include summarized information on trend, alarm, event, and audit for the following database management actions:

    a. Backup.
    b. Purge.
    c. Restore.

4. Database management software shall support the following:

    a. Statistics: Display database server information and trend, alarm, event, and audit information on database.
    b. Maintenance: Include method of purging records from trend, alarm, event and audit databases by supporting separate screens for creating a backup before purging, selecting database, and allowing for retention of a selected number of day's data.
    c. Backup: Include means to create a database backup file and select a storage location.
    d. Restore: Include a restricted means of restoring a database by requiring operator to have proper security level.

5. Database management software shall include information of current database activity, including the following:

    a. Ready.
    b. Purging record from a database.
    c. Action failed.
    d. Refreshing statistics.
    e. Restoring database.
    f. Shrinking a database.
    g. Backing up a database.
    h. Resetting Internet information services.
    i. Starting network device manager.
    j. Shutting down the network device manager.
    k. Action successful.

6. Database management software monitoring functions shall continuously read database information once operator has logged on.

7. Include operator notification through on-screen pop-up display and e-mail message when database value has exceeded a warning or alarm limit.

8. Monitoring settings window shall have the following sections:

    a. Allow operator to set and review scan intervals and start times.
    b. E-mail: Allow operator to create and review e-mail and phone text messages to be delivered when a warning or an alarm is generated.
    c. Warning: Allow operator to define warning limit parameters, set reminder frequency and link e-mail message.
    d. Alarm: Allow operator to define alarm limit parameters, set reminder frequency and link e-mail message.
    e. Database Login: Protect system from unauthorized database manipulation by creating a read access and a write access for each of trend, alarm, event and audit databases as well as operator proper

security access to restore a database.

9. Monitoring settings taskbar shall include the following informational icons:

   a. Normal: Indicates by color and size, or other easily identifiable means that all databases are within their limits.
   b. Warning: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their warning limit.
   c. Alarm: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their alarm limit.

2.10 ASHRAE 135 GATEWAYS

A. Include BACnet communication ports, whenever available as an equipment OEM standard option, for integration via a single communication cable. BACnet-controlled plant equipment includes, but is not limited to, boilers, chillers, ERV's and variable-speed drives.
B. Include gateways to connect BACnet to legacy systems, existing non-BACnet devices, and existing non-BACnet BAS-controlled equipment, only when specifically requested and approved by Owner.
C. Include with each gateway an interoperability schedule showing each point or event on legacy side that BACnet "client" will read, and each parameter that BACnet network will write to. Describe this interoperability of BACnet services, or BIBBs, defined in ASHRAE 135, Annex K.
D. Gateway Minimum Requirements:

   1. Read and view all readable object properties on non-BACnet network to BACnet network and vice versa where applicable.
   2. Write to all writeable object properties on non-BACnet network from BACnet network and vice versa where applicable.
   3. Include single-pass (only one protocol to BACnet without intermediary protocols) translation from non-BACnet protocol to BACnet and vice versa.
   4. Comply with requirements of Data Sharing Read Property, Data Sharing Write Property, Device Management Dynamic Device Binding-B, and Device Management Communication Control BIBBs according to ASHRAE 135.
   5. Hardware, software, software licenses, and configuration tools for operator-to-gateway communications.
   6. Backup programming and parameters on CD media and the ability to modify, download, backup, and restore gateway configuration.

2.11 BAS CONTROLLERS

A. BAS shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.
B. BAS controllers shall perform monitoring, control, energy optimization and other requirements indicated.
C. BAS controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.
D. Each BAS controller shall be capable of full and complete operation as a completely independent unit and as a part of a BAS wide distributed network.
E. Environment Requirements:

   1. Controller hardware shall be suitable for the anticipated ambient conditions.
   2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F.

3. Controllers located outdoors shall be rated for operation at -25 to 120 deg F.

F. Power and Noise Immunity:

1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches of enclosure.

G. BAS Controller Spare Processing Capacity:

1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:

a. Network Controllers: 50 percent.
b. Programmable Application Controllers: Not less than 60 percent.
c. Application-Specific Controllers: Not less than 70 percent.

2. Memory shall support BAS controller's operating system and database and shall include the following:

a. Monitoring and control.
b. Energy management, operation and optimization applications.
c. Alarm management.
d. Historical trend data of all connected I/O points.
e. Maintenance applications.
f. Operator interfaces.
g. Monitoring of manual overrides.

H. BAS Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:

1. Network, Programmable Application, and Application Specific Controllers:

a. 20 percent of each AI, AO, BI, and BO point connected to controller.
b. Minimum Spare I/O Points per Controller:

1) AIs: Three
2) AOs: Three.
3) BIs: Three.
4) BOs: Three.

I. Maintenance and Support: Include the following features to facilitate maintenance and support:

1. Mount microprocessor components on circuit cards for ease of removal and replacement.
2. Means to quickly and easily disconnect controller from network.
3. Means to quickly and easily access connect to field test equipment.
4. Visual indication that controller electric power is on, of communication fault or trouble, and that controller is receiving and sending signals to network.

2.12 NETWORK AND PROGRAMMABLE APPLICATION CONTROLLERS

A. General Network Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.

2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers that perform scheduling shall have a real-time clock.
7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
8. Controllers shall be fully programmable.

B. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation or mobile device.

C. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.13 APPLICATION-SPECIFIC CONTROLLERS

A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.

1. Capable of standalone operation and shall continue to include control functions without being connected to network.
2. Data shall be shared between networked controllers and other network devices.

B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.

C. Operator Interface: Controller shall be equipped with a service communications port for connection to a portable operator's workstation.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall use nonvolatile memory and maintain all BIOS and programming information in event of power loss.

2.14 CONTROLLER SOFTWARE

A. General Controller Software Requirements:

1. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations.
2. Control functions shall be executed within controllers using BAS algorithms.
3. Controllers shall be configured to use stored default values to ensure fail-safe operation. Default values shall be used when there is a failure of a connected input instrument or loss of communication of a global point value.

B. Security:

1. Operator access shall be secured using individual security passwords and user names.
2. Passwords shall restrict operator to points, applications, and system functions as assigned by system manager.
3. Operator log-on and log-off attempts shall be recorded.
4. System shall protect itself from unauthorized use by automatically logging off after last keystroke. The delay time shall be operator-definable.

C. Scheduling: Include capability to schedule each point or group of points in system. Each schedule shall consist of the following:

1. Weekly Schedule:

a. Include separate schedules for each day of week.
b. Each schedule should include the capability for start, stop, optimal start, optimal stop, and night economizer.
c. Each schedule may consist of up to 10 events.
d. When a group of objects are scheduled together, include capability to adjust start and stop times for each member.

2. Exception Schedules:

a. Include ability for operator to designate any day of the year as an exception schedule.
b. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by regular schedule for that day of week.

3. Holiday Schedules:

a. Include capability for operator to define up to 99 special or holiday schedules.
b. Schedules may be placed on scheduling calendar and will be repeated each year.
c. Operator shall be able to define length of each holiday period.

D. System Coordination:

1. Include standard application for proper coordination of equipment.
2. Application shall include operator with a method of grouping together equipment based on function and location.
3. Group may then be used for scheduling and other applications.

E. Binary Alarms:

1. Each binary point shall be set to alarm based on operator-specified state.
2. Include capability to automatically and manually disable alarming.

F. Analog Alarms:

1. Each analog object shall have both high and low alarm limits.
2. Alarming shall be able to be automatically and manually disabled.

G. Alarm Reporting:

1. Operator shall be able to determine action to be taken in event of an alarm.
2. Alarms shall be routed to appropriate operator workstations based on time and other conditions.
3. Alarm shall be able to start programs, print, be logged in event log, generate custom messages, and display graphics.

H. Remote Communication:

1. System shall have ability to dial out in the event of an alarm.

I. Electric Power Demand Limiting (when applicable):

1. Demand-limiting program shall monitor building or other operator-defined electric power consumption from signals connected to electric power meter or from a watt transducer or current transformer.
2. Demand-limiting program shall predict probable power demand such that action can be taken to prevent exceeding demand limit. When demand prediction exceeds demand limit, action will be taken to reduce loads in a predetermined manner. When demand prediction indicates demand limit will not be exceeded, action will be taken to restore loads in a predetermined manner.
3. Demand reduction shall be accomplished by the following means:

    a. Reset air-handling unit supply temperature set points.
    b. Reset space temperature set points.
    c. De-energize equipment based on priority.

4. Demand-limiting parameters, frequency of calculations, time intervals, and other relevant variables shall be based on the means by which electric power service provider computes demand charges.
5. Include demand-limiting prediction and control for any individual meter monitored by system or for total of any combination of meters.
6. Include means operator to make the following changes online:

    a. Addition and deletion of loads controlled.
    b. Changes in demand intervals.
    c. Changes in demand limit for meter(s).
    d. Maximum shutoff time for equipment.
    e. Minimum shutoff time for equipment.
    f. Select rotational or sequential shedding and restoring.
    g. Shed and restore priority.

7. Include the following information and reports, to be available on an hourly, daily, weekly, monthly and annual basis:

a. Total electric consumption.
b. Peak demand.
c. Date and time of peak demand.
d. Daily peak demand.

J. Maintenance Management (when applicable): System shall monitor equipment status and generate maintenance messages based on operator-designated run-time, starts, and calendar date limits.

K. Sequencing: Include application software based on sequences of operation indicated to properly sequence chillers, boilers, and other applicable HVAC equipment.

L. Control Loops:

1. Support any of the following control loops, as applicable to control required:

a. Two-position (on/off, open/close, slow/fast) control.
b. Proportional control.
c. Proportional plus integral (PI) control.
d. Proportional plus integral plus derivative (PID) control.

1) Include PID algorithms with direct or reverse action and anti-windup.
2) Algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs.
3) Controlled variable, set point, and PID gains shall be operator-selectable.

e. Adaptive (automatic tuning).

M. Staggered Start: Application shall prevent all controlled equipment from simultaneously restarting after a power outage. Order which equipment (or groups of equipment) is started, along with the time delay between starts, shall be operator-selectable.

N. Energy Calculations:

1. Include software to allow instantaneous power or flow rates to be accumulated and converted to energy usage data.
2. Include an algorithm that calculates a sliding-window average (rolling average). Algorithm shall be flexible to allow window intervals to be operator specified (such as 15, 30, or 60 minutes).
3. Include an algorithm that calculates a fixed-window average. A digital input signal shall define start of window period (such as signal from utility meter) to synchronize fixed-window average with that used by utility.

O. Anti-Short Cycling:

1. BO points shall be protected from short cycling.
2. Feature shall allow minimum on-time and off-time to be selected.

P. On and Off Control with Differential:

1. Include an algorithm that allows a BO to be cycled based on a controlled variable and set point.
2. Algorithm shall be direct- or reverse-acting and incorporate an adjustable differential.

Q. Run-Time Totalization:

1. Include software to totalize run-times for all BI points.
2. A high run-time alarm shall be assigned, if required, by operator.

2.15 ENCLOSURES

A. General Enclosure Requirements:

1. House each controller and associated control accessories in an enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.
2. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
3. Equip doors of enclosures housing controllers and components with analog or digital displays with windows to allow visual observation of displays without opening enclosure door.
4. Include wall-mounted enclosures with brackets suitable for mounting enclosures to wall or freestanding support stand as indicated.
5. Supply each enclosure with a complete set of as-built schematics, tubing, and wiring diagrams and product literature located in a pocket on inside of door.

B. Internal Arrangement:

1. Internal layout of enclosure shall group and protect pneumatic, electric, and electronic components associated with a controller, but not an integral part of controller.
2. Include a barrier between line-voltage and low-voltage electrical and electronic products.
3. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.
4. Terminate field cable and wire using heavy-duty terminal blocks.
5. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
6. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background.
7. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.
8. Label each end of cable, wire and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.

C. Environmental Requirements:

1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
2. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
3. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.

2.16 RELAYS

A. General-Purpose Relays:

1. Relays shall be heavy duty and rated for at least 10 A at 250-V ac and 60 Hz.

2. Relays shall be either double pole double throw (DPDT) or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with an eight-pin octal plug for DPDT relays and an 11-pin octal plug for three-pole double-throw relays.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Relays shall have LED indication and a manual reset and push-to-test button.
7. Performance:

    a. Mechanical Life: At least 10 million cycles.
    b. Electrical Life: At least 100,000 cycles at rated load.
    c. Pickup Time: 15 ms or less.
    d. Dropout Time: 10 ms or less.
    e. Pull-in Voltage: 85 percent of rated voltage.
    f. Dropout Voltage: 50 percent of nominal rated voltage.
    g. Power Consumption: 2 VA.

8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

B. Multifunction Time-Delay Relays:

1. Relays shall be continuous duty and rated for at least 10 A at 240-V ac and 60 Hz.
2. Relays shall be DPDT relay with up to eight programmable functions to provide on/off delay, interval and recycle timing functions.
3. Use a plug-in-style relay with either an 8- or 11-pin octal plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a dust-tight cover.
6. Include knob and dial scale for setting delay time.
7. Performance:

    a. Mechanical Life: At least 10 million cycles.
    b. Electrical Life: At least 100,000 cycles at rated load.
    c. Timing Ranges: Multiple ranges from 0.1 seconds to 100 minutes.
    d. Repeatability: Within 2 percent.
    e. Recycle Time: 45 ms.
    f. Minimum Pulse Width Control: 50 ms.
    g. Power Consumption: 5 VA or less at 120-V ac.

8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

C. Latching Relays:

1. Relays shall be continuous duty and rated for at least 10 A at 250-V ac and 60 Hz.

2. Relays shall be either DPDT or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with a multibladed plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Performance:

    a. Mechanical Life: At least 10 million cycles.
    b. Electrical Life: At least 100,000 cycles at rated load.
    c. Pickup Time: 15 ms or less.
    d. Dropout Time: 10 ms or less.
    e. Pull-in Voltage: 85 percent of rated voltage.
    f. Dropout Voltage: 50 percent of nominal rated voltage.
    g. Power Consumption: 2 VA.

7. Equip relays with coil transient suppression to limit transients to non-damaging levels.
8. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
9. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

D. Current Sensing Relay:

1. Monitors ac current.
2. Independent adjustable controls for pickup and dropout current.
3. Energized when supply voltage is present and current is above pickup setting.
4. De-energizes when monitored current is below dropout current.
5. Dropout current is adjustable from 50 to 95 percent of pickup current.
6. Include a current transformer, if required for application.
7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.

E. Combination On-Off Status Sensor and On-Off Relay:

1. Description:

    a. On-off control and status indication in a single device.
    b. LED status indication of activated relay and current trigger.
    c. Closed-Open-Auto override switch located on the load side of the relay.

2. Performance:

    a. Ambient Temperature: Minus 30 to 140 deg F.
    b. Voltage Rating: Single-phase loads rated for 300-V ac. Three-phase loads rated for 600-V ac.

3. Status Indication:

    a. Current Sensor: Integral sensing for single-phase loads up to 20 A and external solid or split sensing ring for three-phase loads up to 150 A.
    b. Current Sensor Range: As required by application.
    c. Current Set Point: Fixed or adjustable as required by application.
    d. Current Sensor Output:

1) Solid-state, single-pole double-throw contact rated for 30-V ac and dc and for 0.4 A.
2) Solid-state, single-pole double-throw contact rated for 120-V ac and 1.0 A.
3) Analog, zero- to 5- or 10-V dc.
4) Analog, 4 to 20 mA, loop powered.

4. Relay: Single-pole double-throw, continuous-duty coil; rated for 10-million mechanical cycles.
5. Enclosure: NEMA 250, Type 1 enclosure.

2.17 ELECTRICAL POWER DEVICES

A. Transformers:

1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
2. Transformer shall be at least 40 VA.
3. Transformer shall have both primary and secondary fuses.

2.18 CONTROL WIRE AND CABLE

A. Wire: Single conductor control wiring above 24 V.

1. Wire size shall be at least No. 18 AWG.
2. Conductor shall be 7/24 soft annealed copper strand.
3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 deg C according to UL 83.
4. Conductor colors shall be black (hot), white (neutral), and green (ground).
5. Furnish wire on spools.
6. Cable shall be plenum rated where installed in return air plenums.

B. Single Twisted Shielded Instrumentation Cable above 24 V:

1. Wire size shall be a minimum No. 18 AWG.
2. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
3. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
4. Outer jacket insulation shall have a 600-V, 90-deg C rating and shall be Type TC cable.
5. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
6. Furnish wire on spools.
7. Cable shall be plenum rated when installed in return air plenums.

C. Single Twisted Shielded Instrumentation Cable 24 V and Less:

1. Wire size shall be a minimum No. 22 AWG.
2. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC.
3. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
4. Outer jacket insulation shall have a 300-V, 105-deg C rating and shall be Type PLTC cable.

5. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
6. Furnish wire on spools.
7. Cable shall be plenum rated when installed in return air plenums.

D. LAN and Communication Cable: Comply with BAS manufacturer requirements for network being installed.

1. Cable shall be balanced twisted pair.
2. Comply with the following requirements and for balanced twisted pair cable described in Division 26 – Electrical.

a. Cable shall be plenum rated.
b. Cable shall have a unique color that is different from other cables used on Project.

2.19 RACEWAYS, FIBER OPTICS AND CONNECTORS

A. Comply with requirements in Division 26 and 27.

2.20 ACCESSORIES

A. Pressure Electric Switches:

1. Diaphragm-operated snap acting switch.
2. Set point adjustable from 3 to 20 psig.
3. Differential adjustable from 2 to 6 psig.
4. Rated for resistance loads at 120-V ac.
5. Body and switch housing shall be metal.

B. Damper Blade Limit Switches:

1. Sense positive open and/or closed position of the damper blades.
2. NEMA 250, Type 13, oil-tight construction.
3. Arrange for the mounting application.
4. Additional waterproof enclosure when required by its environment.
5. Arrange to prevent "over-center" operation.

C. I/P and E/P Transducers:

1. Commercial Grade:

a. The transducer shall convert an AO signal to a stepped pneumatic signal. Unless otherwise required by the operating sequence, use a 3- to 15-psig pneumatic signal for pneumatic actuation.
b. Construct the entire assembly so that shock and vibration will neither harm the transducer nor affect its accuracy.
c. Transducer shall have auto/manual output switch, manual output control and an output pressure gage.
d. Accuracy: Within 1.0 percent of the output span.
e. Linearity: Within 0.5 percent of the output span.
f. Output Capacity: Not less than 550 scim at 15 psig.
g. Transducer shall have separate zero and span calibration adjustments.
h. The transducer shall withstand up to 40 psig of supply pressure without damage.

i. For use on only modulating pneumatic outputs that are associated with terminal units, including fan-coil units, VAV units, and unit heaters.

D. E/P Switch:

1. Construct the body of cast aluminum or brass; three pipe body (common, normally open, and normally closed).
2. Internal construction of steel, copper or brass.
3. Air Connections: Barb.
4. Rating of 30 psig when installed in systems below 25 psig.
5. Include coil transient suppression.

E. Instrument Enclosures:

1. Include instrument enclosure for secondary protection to comply with requirements indicated in "Performance Requirements" Article.
2. NRTL listed and labeled to UL 50.
3. Sized to include at least 25 percent spare area on subpanel.
4. Instrument(s) mounted within enclosure on internal subpanel(s).
5. Enclosure face with engraved, laminated phenolic nameplate for each instrument within enclosure.
6. Enclosures housing pneumatic instruments shall include main pressure gage and a branch pressure gage for each pneumatic device, installed inside.
7. Enclosures housing multiple instruments shall route tubing and wiring within enclosure in a raceway having a continuous removable cover.
8. Equip enclosure with lock and common key.

F. Manual Valves:

1. Needle Type:

a. PTFE packing.
b. Construct of brass for use with copper and polyethylene tubing and of stainless steel for use with stainless-steel tubing.
c. Aluminum T-bar handle.
d. Include tubing connections.

2. Ball Type:

a. Body: Bronze ASTM B 62 or ASTM B 61.
b. Ball: Type 316 stainless steel.
c. Stem: Type 316 stainless steel.
d. Seats: Reinforced PTFE.
e. Packing Ring: Reinforced PTFE.
f. Lever: Stainless steel with a vinyl grip.
g. 600 WOG.
h. Threaded end connections.

2.21 IDENTIFICATION

A. Control Equipment, Instruments, and Control Devices:

1. Self-adhesive label, laminated acrylic or melamine plastic sign bearing unique identification.

a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.

2. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require additional identification.

B. Equipment Warning Labels:

1. Self-adhesive label with pressure-sensitive adhesive back and peel-off protective jacket.
2. Lettering size shall be at least 14-point type with white lettering on red background.
3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.25 inch beyond white border.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates.

B. Examine roughing-in for products to verify actual locations of connections before installation.

1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.
D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BAS INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

A. Communication Interface to Equipment with Integral Controls:

1. BAS shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control.

B. Communication Interface to Other Building Systems:

1. BAS shall have a communication interface with systems having a communication interface.

3.3 BAS SYSTEM INTERFACE WITH EXISTING SYSTEMS

A. Interface with Existing Systems:

1. BAS shall interface existing systems to achieve integration.
2. Integration of Existing Control System into BAS:

a. Existing control system performance requirements shall be satisfied when monitoring and controlling existing control system through BAS.
b. Operator shall be able to upload, download, monitor, alarm, report, trend, control and program every input and output point in existing system from DDC system using operator workstations and software provided. The combined systems shall share one database.
c. Interface of existing control system I/O points into BAS shall be transparent to operators. All operational capabilities shall be identical regardless of whether I/O already exists or I/O is being installed.

3.4 CONTROL DEVICES FOR INSTALLATION BY INSTALLERS

A. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.
B. Deliver the following to duct fabricator and Installer for installation in ductwork. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. BAS control dampers, airflow sensors and switches, and pressure sensors.

C. Deliver the following to plumbing and HVAC piping installers for installation in piping. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. BAS control valves, flow meters; pipe-mounted sensors, switches and transmitters; tank-mounted sensors, switches and transmitters; pipe- and tank-mounted thermos-wells.

3.5 CONTROL DEVICES FOR EQUIPMENT MANUFACTURER FACTORY INSTALLATION

A. When applicable, deliver control devices to air-handling or terminal unit equipment manufacturer for factory installation. Include installation instructions to air-handling unit manufacturer. Control devices may include, but are not limited to: Application specific controllers, control valves and dampers, actuators, sensors, switches, transmitters, and relays.

3.6 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.
B. Install products level, plumb, parallel, and perpendicular with building construction.
C. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment when subjected to a force.
D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.
E. Thermostat or temperature sensors installed on masonry walls, whether interior or exterior walls shall be mounted on insulated sub-bases. The purpose of the sub-base is to isolate the sensor from the masonry block that could retain its lower or higher unoccupied set-point temperature much longer due to the mass of the wall. The sub-

base shall be equal to a Bapi 1/4” foam insulating sub-base that is self-adhering to the back of the thermostat.

F. Install a Bapi, or equal self-adhering 1/4” foam backing with pre-cut slit for wiring penetration to the back of any temperature sensor that is installed in a J-Box or other mounting device that may have an open conduit communicating to above a cold ceiling plenum that would transmit cold air down to the sensor and affect the sensors accuracy.

G. Firestop Penetrations made in fire-rated assemblies shall comply with requirements in applicable specification section covering penetration of fire-stopping.

H. Seal penetrations made in acoustically rated assemblies.

I. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

J. Corrosive Environments:

1. Avoid or limit use of materials in corrosive airstreams and environments, including, but not limited to, the following:

   a. Laboratory exhaust-air streams.
   b. Process exhaust-air streams.

2. When conduit is in contact with a corrosive airstream and environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment. Comply with requirements for installation of raceways and boxes specified in Division 26.
3. Where instruments are located in a corrosive airstream and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.7 GATEWAY INSTALLATION

A. Install gateways if required for BAS system communication interface requirements indicated.

1. Install gateway(s) required to suit indicated requirements.

B. Test gateway to verify that communication interface functions properly.

3.8 ROUTER INSTALLATION

A. Install routers if required for BAS system communication interface requirements indicated.

1. Install router(s) required to suit indicated requirements.

B. Test router to verify that communication interface functions properly.

3.9 CONTROLLER INSTALLATION

A. Install controllers in enclosures to comply with indicated requirements.

B. Connect controllers to field power supply.

C. Install controller with latest version of applicable software and configure to execute requirements indicated.

D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

E. Installation of Network and Programmable Application Controllers:

1. Quantity and location of network controllers shall be determined by BAS manufacturer to satisfy requirements indicated.
2. Install controllers in a protected location that is easily accessible by operators.
3. Top of controller shall be within 72 inches of finished floor.

F. Application-Specific Controllers:

1. Quantity and location of application-specific controllers shall be determined by BAS manufacturer to satisfy requirements indicated.
2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

3.10 INSTALLATION OF WIRELESS ROUTERS FOR OPERATOR INTERFACE

A. Install wireless routers to achieve optimum performance and best possible coverage.
B. Mount wireless routers in a protected location that is within 60 inches of floor and easily accessible by operators.
C. Connect wireless routers to field power supply and to UPS units if network controllers are powered through UPS units.
D. Install wireless router with latest version of applicable software and configure wireless router with WPA2 security and password protection. Create access password with not less than 12 characters consisting of letters and numbers and at least one special character. Document password in operations and maintenance manuals for reference by operators.
E. Test and adjust wireless routers for proper operation with portable workstation and other wireless devices intended for use by operators.

3.11 ENCLOSURES INSTALLATION

A. Install the following items in enclosures, to comply with indicated requirements:

1. Gateways.
2. Routers.
3. Controllers.
4. Relays.
5. Accessories.
6. Instruments.

B. Attach wall-mounted enclosures to indoor wall using painted steel struts and hardware. Use stainless-steel strut and hardware for mounting enclosures located outdoors.
C. Align top or bottom of adjacent enclosures.
D. Install floor-mounted enclosures located in mechanical equipment rooms on concrete housekeeping pads. Attach enclosure legs using galvanized or stainless steel anchors.
E. Install continuous and fully accessible wireways to connect conduit, wire, and cable to multiple adjacent enclosures. Wireway used for application shall have protection equal to NEMA 250 rating of connected enclosures.

3.12 ELECTRIC POWER CONNECTIONS

A. Connect electrical power to BAS products requiring electrical power connections.
B. Coordinate location of all electrical power drops to products with Electrical Contractor.

3.13 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals.

B. Install self-adhesive labels laminated acrylic or melamine plastic signs with unique identification on face for each of the following:

1. Gateway.
2. Router.
3. Protocol analyzer.
4. BAS controllers.
5. Enclosures.

C. Install instrument identification on face of each instrument connected to a BAS controller.
D. Warning Labels and Signs:

1. Shall be permanently attached to equipment that can be automatically started by BAS.
2. Shall be located in highly visible location near power service entry points.

3.14 NETWORK INSTALLATION

A. Install optical fiber cable when connecting between the following network devices and when located in different buildings on campus and Owners fiber is not available for BAS use.

1. Operator workstations.
2. Operator workstations and network controllers.
3. Network controllers.

B. Install balanced twisted pair or optical fiber cable when connecting between the following network devices located in same building:

1. Operator workstations.
2. Operator workstations and network controllers.
3. Network controllers.

C. Install balanced twisted pair or copper cable (as required by equipment) when connecting between the following:

1. Gateways.
2. Gateways and network controllers or programmable application controllers.
3. Routers.
4. Routers and network controllers or programmable application controllers.
5. Network controllers and programmable application controllers.
6. Programmable application controllers.
7. Programmable application controllers and application-specific controllers.
8. Application-specific controllers.

D. Install cable in continuous raceway.

1. When pre-approved or where indicated on Drawings, cable trays may be used for copper cable in lieu of conduit.

3.15 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.
B. ASHRAE 135 Networks:

1. MAC Address:

    a. Every network device shall have an assigned and documented MAC address unique to its network.
    b. Ethernet Networks: Document MAC address assigned at its creation.
    c. ARCNET or MS/TP networks: Assign from 00 to 64.

2. Network Numbering:

    a. Assign unique numbers to each new network.
    b. Provide ability for changing network number through device switches or operator interface.
    c. DDC system, with all possible connected LANs, can contain up to 65,534 unique networks.

3. Device Object Identifier Property Number:

    a. Assign unique device object identifier property numbers or device instances for each device network.
    b. Provide for future modification of device instance number by device switches or operator interface.
    c. LAN shall support up to 4,194,302 unique devices.

4. Device Object Name Property Text:

    a. Device object name property field shall support 32 minimum printable characters.
    b. Assign unique device "Object Name" property names with plain-English descriptive names for each device.

        1) Example 1: Device object name for device controlling boiler plant at Building 1000 would be "HW System B1000."
        2) Example 2: Device object name for a VAV terminal unit controller could be "VAV unit 102".

5. Object Name Property Text for Other Than Device Objects:

    a. Object name property field shall support 32 minimum printable characters.
    b. Assign object name properties with plain-English names descriptive of application.

        1) Example 1: "Zone 1 Temperature."
        2) Example 2 "Fan Start and Stop."

6. Object Identifier Property Number for Other Than Device Objects:

    a. Assign object identifier property numbers according to [**Drawings**] [**or**] [**tables**] indicated.
    b. If not indicated, object identifier property numbers may be assigned at Installer's discretion but must be approved by Owner in advance, be documented and be unique for like object types within device.

3.16 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

A. Comply with NEMA 1.

B. Wire and Cable Installation:

1. Comply with installation requirements of Divisions 26 and 27 when applicable.
2. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.
   a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.
3. Terminate wiring in a junction box.
   a. Clamp cable over jacket in junction box.
   b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.
4. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
5. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.
6. Use shielded cable to transmitters.
7. Use shielded cable to temperature sensors.
8. Perform continuity and meager testing on wire and cable after installation.

C. Conduit Installation:

1. Comply with applicable sections of Division 26 and 27.

3.17 BAS SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests and calibration.
B. Check instruments for proper location and accessibility.
C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.
E. Control Damper Checkout:

1. For pneumatic dampers, verify that pressure gages are provided in each air line to damper actuator and positioner.
2. Verify that control dampers are installed correctly for flow direction.
3. Verify that proper blade alignment, either parallel or opposed, has been provided.
4. Verify that damper frame attachment is properly secured and sealed.
5. Verify that damper actuator and linkage attachment is secure.
6. Verify that actuator wiring is complete, enclosed and connected to correct power source.
7. Verify that damper blade travel is unobstructed.

F. Control Valve Checkout:

1. For pneumatic valves, verify that pressure gages are provided in each air line to valve actuator and positioner.
2. Verify that control valves are installed correctly for flow direction.
3. Verify that valve body attachment is properly secured and sealed.
4. Verify that valve actuator and linkage attachment is secure.
5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
6. Verify that valve ball, disc or plug travel is unobstructed.
7. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop

leaks. Replace the valve if leaks persist.

G. Instrument Checkout:

1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
2. Verify that attachment is properly secured and sealed.
3. Verify that conduit connections are properly secured and sealed.
4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
5. Inspect instrument tag against approved submittal.
6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
8. For temperature instruments:

a. Verify sensing element type and proper material.
b. Verify length and insertion.

3.18 BAS SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:

A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.
E. Provide diagnostic and test equipment for calibration and adjustment.
F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
I. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.
J. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

K. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact making or breaking.

L. Control Dampers:

1. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed and 100 percent open at proper air pressure.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

M. Control Valves:

1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed and 100 percent open at proper air pressures.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

N. Meters: Check sensors at zero, 50, and 100 percent of Project design values.
O. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.
P. Switches: Calibrate switches to make or break contact at set points indicated.
Q. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

3.19 BAS CONTROLLER CHECKOUT

A. Verify power supply.

1. Verify voltage, phase and hertz.
2. Verify that protection from power surges is installed and functioning.
3. Verify that ground fault protection is installed.
4. If applicable, verify if connected to UPS unit.
5. If applicable, verify if connected to a backup power source.
6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.

B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.
C. Verify that spare I/O capacity is provided.

3.20 BAS CONTROLLER I/O CONTROL LOOP TESTS

A. Testing:

1. Test every I/O point connected to BAS controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
2. Test every I/O point throughout its full operating range.
3. Test every control loop to verify operation is stable and accurate.
4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
5. Test and adjust every control loop for proper operation according to sequence of operation.
6. Test software and hardware interlocks for proper operation. Correct deficiencies.
7. Operate each analog point at the following:

    a. Upper quarter of range.
    b. Lower quarter of range.
    c. At midpoint of range.

8. Exercise each binary point.
9. For every I/O point in BAS, read and record each value at operator workstation, at BAS controller and at field instrument simultaneously. Value displayed at operator workstation, at BAS controller and at field instrument shall match.
10. Prepare and submit a report documenting results for each I/O point in BAS and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

3.21 BAS SYSTEM VALIDATION TESTS

A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.
B. After approval of Test Plan, execute all tests and procedures indicated in plan.
C. After testing is complete, submit completed test checklist.
D. Pretest Checklist: Submit the following list with items checked off once verified:

1. Detailed explanation for any items that are not completed or verified.
2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
3. HVAC equipment motors operate below full-load amperage ratings.
4. Required BAS system components, wiring, and accessories are installed.
5. Installed BAS system architecture matches approved Drawings.
6. Control electric power circuits operate at proper voltage and are free from faults.
7. Required surge protection is installed.
8. BAS system network communications function properly, including uploading and downloading programming changes.
9. Using BACnet protocol analyzer, verify that communications are error free.
10. Each controller's programming is backed up.
11. Equipment, products, tubing, wiring cable and conduits are properly labeled.
12. All I/O points are programmed into controllers.
13. Testing, adjusting and balancing work affecting controls is complete.
14. Dampers and actuators zero and span adjustments are set properly.
15. Each control damper and actuator goes to failed position on loss of power.
16. Valves and actuators zero and span adjustments are set properly.
17. Each control valve and actuator goes to failed position on loss of power.
18. Meter, sensor and transmitter readings are accurate and calibrated.
19. Control loops are tuned for smooth and stable operation.
20. View trend data where applicable.
21. Each controller works properly in standalone mode.

22. Safety controls and devices function properly.
23. Interfaces with fire-alarm system function properly.
24. Electrical interlocks function properly.
25. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphic are created.
26. Record Drawings are completed.

E. Test Plan:

1. Prepare and submit a validation test plan including test procedures for performance validation tests.
2. Test plan shall address all specified functions of BAS system and sequences of operation.
3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
4. Explain method for simulating necessary conditions of operation used to demonstrate performance.
5. Include a test checklist to be used to check and initial that each test has been successfully completed.
6. Submit test plan documentation 10 business days before start of tests.

F. Validation Test:

1. Verify operating performance of each I/O point in BAS.

    a. Verify analog I/O points at operating value.
    b. Make adjustments to out-of-tolerance I/O points.

        1) Identify I/O points for future reference.
        2) Simulate abnormal conditions to demonstrate proper function of safety devices.
        3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.

2. Simulate conditions to demonstrate proper sequence of control.
3. Readjust settings to design values and observe ability of BAS to establish desired conditions.
4. After 24 Hours following Initial Validation Test:

    a. Re-check I/O points that required corrections during initial test.
    b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.

5. After 24 Hours of Second Validation Test:

    a. Re-check I/O points that required corrections during second test.
    b. Continue validation testing until I/O point is normal on two consecutive tests.

6. Completely check out, calibrate, and test all connected hardware and software to ensure that BAS performs according to requirements indicated.
7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.

G. BAS Network Bandwidth Test:

1. Test network bandwidth usage on all BAS networks to demonstrate bandwidth usage under BAS normal operating conditions and under simulated HLC.
2. To pass, none of BAS system networks shall use more than 70 percent of available bandwidth under normal and HLC operation.

3.22 BAS WIRELESS NETWORK VERIFICATION

A. BAS Installer shall design wireless BAS networks to comply with performance requirements indicated.
B. Installer shall verify wireless network performance through field testing and shall document results in a field test report.
C. Testing and verification of all wireless devices shall include, but not be limited to, the following:

1. Speed.
2. Online status.
3. Signal strength.

3.23 FINAL REVIEW

A. Submit written request to Engineer, General Contractor or Construction Manager when BAS is ready for final review. Written request shall state the following:

1. BAS has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
2. BAS has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
3. BAS monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
4. BAS is complete and ready for final review.

B. Review by Engineer, and General Contractor or Construction Manager shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.
C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.
D. Should more than two reviews be required, BAS manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by BAS manufacturer and Installer before making the review.
E. Prepare and submit closeout submittals when no deficiencies are reported.
F. A part of BAS final review shall include a demonstration to parties participating in final review.

1. Provide staff familiar with BAS installed to demonstrate operation of BAS during final review.
2. Provide testing equipment to demonstrate accuracy and other performance requirements of BAS that is requested by reviewers during final review.
3. Demonstration shall include, but not be limited to, the following:

a. Accuracy and calibration of I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not

satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.

b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation.
c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.
d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.
e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.
f. Trends, summaries, logs and reports set-up for Project.
g. For HVAC systems randomly selected by reviewers, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.
h. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.
i. Software's ability to edit control programs off-line.
j. Data entry to show Project-specific customizing capability including parameter changes.
k. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
l. Execution of digital and analog commands in graphic mode.
m. Spreadsheet and curve plot software and its integration with database.
n. Online user guide and help functions.
o. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.
p. System speed of response compared to requirements indicated.
q. For each Network and Programmable Application Controller:

    1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.
    2) Operator Interface: Ability to connect directly to each type of digital controller with a portable workstation and mobile device. Show that maintenance personnel interface tools perform as indicated in manufacturer's technical literature.
    3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.
    4) Electric Power: Ability to disconnect any controller safely from its power source.
    5) Wiring Labels: Match control drawings.
    6) Network Communication: Ability to locate a controller's location on network and communication architecture matches Shop Drawings.
    7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.

r. For Each Operator Workstation:

    1) I/O points lists agree with naming conventions.

2) Graphics are complete.
3) UPS unit, if applicable, operates.

s. Communications and Interoperability: Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. Requirements must be met even if only one manufacturer's equipment is installed.

1) Data Presentation: On each operator workstation, demonstrate graphic display capabilities.
2) Reading of Any Property: Demonstrate ability to read and display any used readable object property of any device on network.
3) Set Point and Parameter Modifications: Show ability to modify set points and tuning parameters indicated.
4) Peer-to-Peer Data Exchange: Network devices are installed and configured to perform without need for operator intervention to implement Project sequence of operation and to share global data.
5) Alarm and Event Management: Alarms and events are installed and prioritized according to Owner. Demonstrate that time delays and other logic are set up to avoid nuisance tripping. Show that operators with sufficient privileges are permitted.
6) Schedule Lists: Schedules are configured for start and stop, mode change, occupant overrides, and night setback as defined in sequence of operations.
7) Schedule Display and Modification: Ability to display any schedule with start and stop times for calendar year. Show that all calendar entries and schedules are modifiable from any connected operator workstation by an operator with sufficient privilege.
8) Archival Storage of Data: Data archiving is handled by operator workstation and server and local trend archiving and display is accomplished.
9) Modification of Trend Log Object Parameters: Operator with sufficient privilege can change logged data points, sampling rate, and trend duration.
10) Device and Network Management:

a) Display of network device status.
b) Display of BACnet Object Information.
c) Silencing devices transmitting erroneous data.
d) Time synchronization.
e) Remote device re-initialization.
f) Backup and restore network device programming and master database(s).
g) Configuration management of routers.

3.24 ADJUSTING

A. Occupancy Adjustments: When requested within 12-months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.25 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12- months' full maintenance by BAS manufacturer's authorized service representative. Include preventive maintenance, repair or replacement of worn or defective components, cleaning, calibration and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.26 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at end of warranty period (one year from Substantial Completion), include in your bid a service agreement that shall include software support for two year(s).
B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within during the warranty period at no cost to Owner. Upgrading software shall include operating system and new or revised licenses for using software.

3.27 DEMONSTRATION

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain BAS.
B. Extent of Training:

1. Base extent of training on scope and complexity of BAS indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
3. Minimum Training Requirements:

a. Provide not less than 8-hours of initial training. This training shall not be counted as the time spent with owner during start-up, testing, or demonstration.
b. After three months, provide an additional 4-hours of dedicated training to review system operations with the Owner, and answer owner questions about operation of the BAS or mechanical components.
c. At approximately 9 to 10-months from the substantial completion, provide 4 additional hours of Owner training. Prior to conducting the training, contact the owner and request in writing a list of questions or concerns the Owner has on the operation or use of the BAS controls. Use this training as a means to specifically answer any questions and run through a refresher of how the system operates and BAS capabilities as far as trending, scheduling, etc.

C. Training Schedule:

1. Schedule training with Owner at least 10-business days before expected Substantial Completion.
2. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday.

D. Training Attendee List and Sign-in Sheet:

1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
3. Preprinted sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
4. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
5. At end of each training session, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

E. Training Attendee Headcount:

1. Plan in advance of training for at least three attendees.
2. Make allowance for Owner to add up to two attendee(s) at time of training.
3. Headcount may vary depending on training content covered in session. Attendee access may be restricted to some training content for purposes of maintaining system security.
4. Training Attendee Prior Knowledge: For guidance in planning required training and instruction, assume attendees have a high school degree and only the basic user knowledge of computers and office applications, basic knowledge of HVAC systems, and little knowledge of BAS.
5. Provide each attendee with a color hard copy of all training materials and visual presentations.

F. Instructor Requirements:

1. Instructors shall have not less than two years of providing instructional training on not less than five past projects with similar BAS scope and complexity to system installed.

G. On-Site Training:

1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Owner.
4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
5. Operator workstation provided with BAS shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

H. Training Content for Daily Operators:

1. Basic operation of system.
2. Understanding BAS architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.

4. Understanding operation of each system and equipment controlled by BAS including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Logging on and off system.
6. Accessing graphics, reports and alarms.
7. Adjusting and changing set points and time schedules.
8. Recognizing BAS malfunctions.
9. Understanding content of operation and maintenance manuals including control drawings.
10. Understanding physical location and placement of BAS controllers and I/O hardware.
11. Accessing data from BAS controllers.
12. Operating portable operator workstations.
13. Running each specified report and log.
14. Displaying and demonstrating data entry to show Project-specific customizing capability. Demonstrating parameter changes.
15. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
16. Executing digital and analog commands in graphic mode.
17. Demonstrating BAS system performance through trend logs and command tracing.
18. Demonstrating on-line user guide, and help function and mail facility.
19. Demonstrating the following for HVAC systems and equipment controlled by BAS:

    a. Operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.
    b. For HVAC equipment with factory-installed software, show that integration into BAS is able to communicate with BAS controllers or gateways, as applicable.
    c. Using graphed trends, show that sequence of operation is executed in correct manner, and HVAC systems operate properly through complete sequence of operation including seasonal change, occupied and unoccupied modes, warm-up and cool-down cycles and other modes of operation indicated.
    d. Reporting of alarm conditions for each alarm, and confirm that alarms are received at assigned locations, including operator workstations.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping and tubing joining materials.
3. Manual gas shutoff valves.
4. Dielectric fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
3. Dielectric fittings.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.5 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of natural-gas service.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: Check with local utility service provider.
3. Minimum Operating Pressure of Service Meter: Check with local utility service provider.

B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
3. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless-steel underground.

4. Mechanical Couplings:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Baker Hughes Company.
        2) Smith-Blair, Inc.
        3) Viega LLC.

    b. Steel flanges and tube with epoxy finish.
    c. Buna-nitrile seals.
    d. Steel bolts, washers, and nuts.
    e. Coupling shall be capable of joining steel pipe to steel pipe.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Aboveground Manual Gas Shutoff Valve Schedule" Article for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Article.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Article.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. A.Y. McDonald Mfg. Co.
    b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    c. BrassCraft Manufacturing Co.; a Masco company.
    d. Lyall, R. W. & Company, Inc.
    e. Perfection Corporation.

2. Body: Bronze, complying with ASTM B584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. A.Y. McDonald Mfg. Co.
    b. Lee Brass Company.

2. Body: Bronze, complying with ASTM B584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Article.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. A.Y. McDonald Mfg. Co.
   b. Mueller Co.
   c. Xomox Corporation.

2. Body: Cast iron, complying with ASTM A126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Article.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. A.Y. McDonald Mfg. Co.
   b. Capitol Manufacturing Company.
   c. Central Plastics Company.
   d. HART Industrial Unions, LLC.
   e. Jomar Valve.
   f. Matco-Norca.
   g. WATTS.
   h. Wilkins.
   i. Zurn Industries, LLC.

2. Description:

   a. Standard: ASSE 1079.
   b. Pressure Rating: 125 psig minimum at 180 deg F.
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Matco-Norca.
d. WATTS.
e. Wilkins.

2. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

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

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install fittings for changes in direction and branch connections.

3.4 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.5 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.6 SUPPORT INSTALLATION

A. Install gas pipe on adjustable stand with polycarbonate base, and strut clamp; quantity and spacing per manufacturer’s instructions.

3.7 CONNECTIONS

A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

B. Install piping adjacent to appliances to allow service and maintenance of appliances.

C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.8 LABELING AND IDENTIFYING

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.9 PAINTING

A. Paint exposed, exterior metal piping and valves with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel.

d. Color: Industrial safety yellow on roof, Utility gray on vertical portions where visible in front of decorative siding material.

B. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

B. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Cast-iron, nonlubricated plug valve.

END OF SECTION

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Steel pipe and fittings.
3. Joining materials.
4. Transition fittings.
5. Dielectric fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Pipe and tube.
2. Fittings.
3. Joining materials.
4. Transition fittings.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 100 psig at 180 deg F
2. Makeup-Water Piping: 150 psig at 250 deg F.
3. Condensate-Drain Piping: 180 deg F.
4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B88, Type L.

B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.

C. Wrought Copper Unions: ASME B16.22.

D. Copper-Tube, Mechanically Formed Tee Fitting: For forming T-branch on copper water tube.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. T-DRILL Industries, Inc.

2. Description: Tee formed in copper tube in accordance with ASTM F2014.

E. Copper-Tube, Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkhart Products Corporation.
b. Mueller Industries, Inc.
c. NIBCO INC.
d. Viega LLC.

2. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end.
3. Minimum 200-psig working-pressure rating at 250 deg F.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

C. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

D. Wrought-Steel Fittings: ASTM A234/A234M, wall thickness to match adjoining pipe.

E. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

F. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International.
b. Central Sprinkler Company.
c. Grinnell G-Fire by Johnson Controls Company.
d. National Fittings, Inc.
e. Nexus Valve, Inc.
f. S. P. Fittings.
g. Smith-Cooper International.
h. Star Pipe Products.
i. Victaulic Company.

2. Joint Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47/A47M, Grade 32510 malleable iron; ASTM A53/A53M, Type F, E, or S, Grade B fabricated steel; or ASTM A106/A106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
3. Couplings: Ductile- or malleable-iron housing and EPDM or nitrile gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.4 JOINING MATERIALS

A. 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 otherwise 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. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. IPEX USA LLC.
c. Uponor.
d. Viega LLC.

2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. IPEX USA LLC.
c. NIBCO INC.
d. Spears Manufacturing Company.

2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A. Y. McDonald Mfg. Co.
b. Capitol Manufacturing Company.
c. Central Plastics Company.
d. HART Industrial Unions, LLC.
e. Jomar Valve.
f. Matco-Norca.
g. WATTS.
h. Wilkins.
i. Zurn Industries.

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig minimum at 180 deg F.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Matco-Norca.
d. WATTS.
e. Wilkins.
f. Zurn Industries.

2. 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.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-seal joints.
2. Schedule 40, Grade B steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Makeup-water piping installed aboveground shall be either of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

3.2 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 230500 "Common Work Results for HVAC."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

U. Comply with requirements in Section 230500 “Common Work Results for HVAC” for the following:

1. Sleeves for piping penetrations of walls, ceilings, and floors.
2. Sleeve seals for piping penetrations of concrete walls and slabs.
3. Escutcheons for piping penetrations of walls, ceilings, and floors.
4. Hangers and support installation.

3.3 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. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.

D. 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.

E. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

H. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tools and procedure, and brazed joints.

I. Pressure-Sealed Joints: Use manufacturer-recommended tools and procedure. Leave insertion marks on pipe after assembly.

3.4 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.5 CHEMICAL TREATMENT

A. Coordinate water treatment requirements with Owner’s treatment representative.

B. Coordinate Fill systems that have antifreeze or glycol solutions with the following concentrations:

1. Hot-Water Heating Piping: Minimum of 30% percent propylene glycol (to be verified with Owner).

3.6 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 230553 "Identification for HVAC Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure and not less than 100 psi. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 15 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.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Hydronic specialty valves.
2. Backflow preventers.
3. Air-control devices.
4. Strainers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product:

1. Include construction details and material descriptions for hydronic piping specialties.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For hydronic piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 HYDRONIC SPECIALTY VALVES

A. Brass, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong Pumps, Inc.
b. Bell & Gossett; a Xylem brand.
c. Hays Fluid Controls.
d. HCI; Hydronics Components Inc.
e. Jomar Valve.
f. Nexus Valve, Inc.
g. NIBCO INC.

h. Red-White Valve Corp.
i. Taco Comfort Solutions.
j. Victaulic Company.
k. WATTS.

2. Body: Lead-free brass (NSF/ANSI 372), ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. End Connections: Threaded or socket.
5. Pressure Gage Connections: Integral seals for portable differential pressure meter.
6. Handle Style: Lever, with memory stop to retain set position.
7. CWP Rating: Minimum 125 psig.
8. Maximum Operating Temperature: 250 deg F.

2.2 BACKFLOW PREVENTERS

A. Acceptable manufacturers are Febco, Beeco, and Watts.

B. Reduced Pressure Backflow Preventers: ANSI/ASSE 1015; bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

C. Backflow preventers in make-up water to heating water systems shall be designed for at least 250F per ASME Sect. IV HG 705

2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMTROL, Inc.
b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
c. Armstrong Pumps, Inc.
d. Bell & Gossett; a Xylem brand.
e. Hays Fluid Controls.
f. HCI; Hydronics Components Inc.
g. Nexus Valve, Inc.
h. NuTech Hydronic Specialty Products
i. Taco Comfort Solutions.
j. WATTS.

2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/8.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 225 deg F.

2.4 STRAINERS

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jomar Valve.
b. Keckley Company.
c. Metraflex Company (The).
d. Titan Flow Control, Inc.
e. WATTS.

2. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
4. Strainer Screen: Stainless-steel, 20-mesh strainer, or perforated stainless-steel basket.
5. CWP Rating: 125 psig.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves in the return pipe of each heating terminal.

C. Install check valves at each pump discharge and elsewhere as required to control flow direction.

D. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

E. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

END OF SECTION

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.
2. Automatic condensate pump units.

1.3 DEFINITIONS

A. EPDM: Ethylene propylene diene monomer.

B. HI: Hydraulic Institute.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of pump.

1. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated.
2. Indicate pump's operating point on curves.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps, Inc.
2. Bell & Gossett; a Xylem brand.
3. Grundfos Pumps Corporation.
4. ITT Corporation.
5. PACO Pumps; Grundfos Pumps Corporation, USA.
6. Patterson Pump Company; a Gorman-Rupp company.
7. Taco Comfort Solutions, Inc.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gauge tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange connections.
2. Impeller: ASTM B584, stainless steel; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft Sleeve: Non-ferrous.
4. Pump Stub Shaft: Solid alloy steel.
5. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and EPDM rubber bellows and gasket. Include water slinger on shaft between motor and seal.
6. Seal Flushing: Flush, cool, and lubricate pump seal by directing pump discharge water to flow over the seal.

D. Shaft Coupling: Rigid, axially-split spacer coupling to allow service of pump seal without disturbing pump or motor.

E. Motor:

1. Enclosure: Totally enclosed, fan cooled.
2. NEMA Premium Efficient motors as defined in NEMA MG 1.
3. 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.
4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.3 AUTOMATIC CONDENSATE PUMP UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Beckett Corporation.
2. Crane Pumps & Systems.
3. Grundfos Pumps Corporation.
4. Hartell Pumps; Milton Roy.
5. Little Giant Pump Co.

B. Source Limitations: Obtain pump units from single source from single manufacturer.

C. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Collects and removes condensate from fan coil units, air handling units, condensing boilers, and similar components. Include factory- or field-installed check valve and 72-inch-minimum, electrical power cord with plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

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

3.2 PUMP INSTALLATION

A. Comply with HI 1.4 for horizontal pump installation and HI 2.4 for vertical pump installation.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

E. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and elastomeric hangers of size required to support weight of in-line pumps.

3.3 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Perform alignment service. When required by manufacturer to maintain warranty coverage, engage a factory-authorized service representative to perform it.

C. Comply with requirements in HI standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

D. Comply with pump and coupling manufacturers' written instructions.

3.4 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install pressure gauges on pump suction and discharge or at integral pressure-gauge tapping, or install single gauge with multiple-input selector valve.

F. Install check valve on each condensate pump unit discharge unless unit has a factory-installed check valve.

3.5 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.6 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping. Use startup strainer for initial startup.
4. Perform the following startup checks for each pump before starting:

a. Verify bearing lubrication.
b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
c. Verify that pump is rotating in correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Hydronic pumps will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

1.3 DEFINITIONS

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

E. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct of [**Type 304**] [**Type 316**] stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ductmate Industries, Inc.

b. Elgen Manufacturing.
c. Linx Industries (formerly Lindab).
d. McGill AirFlow LLC.
e. MKT Metal Manufacturing.
f. Nordfab Ducting.
g. SEMCO, LLC; a part of FlaktGroup.
h. Set Duct Manufacturing.
i. Sheet Metal Connectors, Inc.
j. Spiral Manufacturing Co., Inc.
k. Stamped Fittings Inc.

B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch-minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CertainTeed Corporation; Saint-Gobain North America.
    b. Johns Manville; a Berkshire Hathaway company.
    c. Knauf Insulation.
    d. Owens Corning.

2. Stamped Fittings Inc.
3. Maximum Thermal Conductivity:

    a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

4. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
5. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.

    a. Adhesive shall have a VOC content of 80 g/L or less.
    b. Adhesive shall comply with the testing and product requirements

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.

7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with the testing and product requirements

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. 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."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

D. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.

L. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

M. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPE 1 COMMERCIAL KITCHEN GREASE HOOD EXHAUST DUCT

A. Install ducts in accordance with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operation"; SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; and SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines" unless otherwise indicated.

B. Install all ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

C. All ducts concealed from view shall be stainless steel as per "Duct Schedule" Article.

D. All joints shall be welded and shall be telescoping, bell, or flange joint as per NFPA 96.

E. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.

F. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

G. Refer to Captiveaire Documentation for additional duct specifications.

3.4 DUCTWORK EXPOSED TO WEATHER

A. All external joints are to have secure watertight mechanical connections. Seal all openings to provide weatherproof construction.

B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

C. Single Wall:

1. Ductwork shall be galvanized steel.

2. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct Insulation."

3.5 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.6 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.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 DUCT LINER INSTALLATION

A. When not noted to be lined for conductivity, the first 25 feet of supply and return duct at all air handling equipment shall be lined with 1/2 inch duct liner for sound absorption. The acoustical liner shall be installed even where duct wrap may be required.

B. Linings shall be interrupted at the area of operation of a fire damper and at not less than 6 inches upstream of and 6 inches downstream of electric-resistance and fuel-burning heaters in a duct system. Metal nosings or sleeves shall be installed over exposed duct liner edges that face opposite the direction of airflow.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
3. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."

C. Use duct cleaning methodology as indicated in NADCA ACR.

D. Use service openings for entry and inspection.

1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

E. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

F. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.11 STARTUP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.12 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Supply Ducts:

1. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive 3-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round: 4.

2. Ducts Connected to Variable-Air-Volume Air-Handling Units:

    a. Pressure Class: Positive 4-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 4.
    d. SMACNA Leakage Class for Round: 2.

3. Ducts Connected to Equipment Not Listed Above:

    a. Pressure Class: Positive 2-inch wg.
    b. Minimum SMACNA Seal Class: C.
    c. SMACNA Leakage Class for Rectangular: 16.
    d. SMACNA Leakage Class for Round: 8.

C. Return Ducts:

1. Ducts Connected to Air-Handling Units:

    a. Pressure Class: Positive or negative 3-inch wg.
    b. Minimum SMACNA Seal Class: B.
    c. SMACNA Leakage Class for Rectangular: 8.
    d. SMACNA Leakage Class for Round: 4.

2. Ducts Connected to Equipment Not Listed above:

    a. Pressure Class: Positive or negative 2-inch wg.
    b. Minimum SMACNA Seal Class: C.
    c. SMACNA Leakage Class for Rectangular: 16.
    d. SMACNA Leakage Class for Round: 8.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

    a. Pressure Class: Negative 3-inch wg.
    b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    c. SMACNA Leakage Class for Rectangular: 8.
    d. SMACNA Leakage Class for Round: 4.

2. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.

    a. Concealed: Type 304, stainless-steel sheet, No. 2D finish.
    b. Welded seams and joints.
    c. Airtight/watertight.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

    a. Pressure Class: Positive or negative 2-inch wg.
    b. Minimum SMACNA Seal Class: C.
    c. SMACNA Leakage Class for Rectangular: 16.
    d. SMACNA Leakage Class for Round: 8.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 3-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 4.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 4.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel Galvanized steel or carbon steel coated with zinc-chromate primer.

G. Liner:

1. Supply-Air Ducts: Fibrous glass, Type I, 1/2 inch thick.
2. Return-Air Ducts: Fibrous glass, Type I, 1/2 inch thick.
3. Exhaust-Air Ducts: Fibrous glass, Type I, 1/2 inch thick.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: [**Standing seam**] [**Welded**].

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Conical spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manual volume dampers/balancing dampers.
2. Control dampers.
3. Louvers.
4. Duct-mounted access doors.
5. Flexible connectors.
6. Duct accessory hardware.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop, dynamic insertion loss, and self-generated noise data. Include breakout noise calculations for high-transmission-loss casings.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 90A and NFPA 90B.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MANUAL VOLUME DAMPERS/BALANCING DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance; a division of MESTEK, Inc.

    a. AC111 (Rectangular)
    b. AC112 (Round)

2. Greenheck Fan Corporation.

    a. MBD-10 (Rectangular)
    b. MBDR-50 (Round)

3. McGill AirFlow LLC.

    a. VC8 (Rectangular)
    b. VC9 (Round)

4. Pottorff.

    a. CD-10 (Parallel Blade)
    b. CD-10R (Opposed Blade)

5. Ruskin Company.

    a. MDRS25 (Round)

6. United Enertech.

    a. CD-111 (Parallel Blade)
    b. CD-110 (Opposed Blade)

B. Performance:

1. AMCA Certification: Test and rate in accordance with AMCA 511.
2. Leakage:

    a. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.

3. Velocity: Up to 1500 fpm.
4. Pressure Rating: Low to medium pressure and velocity systems. Up to 1 in. wg pressure differential.

C. Construction:

1. Linkage: Out of airstream.
2. Suitable for horizontal or vertical airflow applications.
3. Frames:

    a. Hat, U, or angle shaped.
    b. Material: Galvanized steel, minimum 22 gauge thick.
    c. Mitered and welded corners.
    d. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:

    a. Multiple or single blade.

b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized, roll-formed steel; minimum 22 gauge thick.

5. Blade Axles: 1/2-inch diameter, plated steel.
6. Bearings:

a. Molded synthetic.
b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

7. Operator: Locking manual quadrant.
8. Tie Bars and Brackets: Galvanized steel.
9. Locking device to hold damper blades in a fixed position without vibration.

2.3 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.

a. VCD-23

2. McGill AirFlow LLC.

a. VC1 (Parallel Blade)
b. VC2 (Opposed Blade)

3. Nailor Industries Inc.

a. 1010 (Parallel Blade)
b. 1020 (Opposed Blade)

4. Pottorff.

a. CD-41 (Parallel Blade)
b. CD-42 (Opposed Blade)

5. United Enertech.

a. CD-111 (Parallel Blade)
b. CD-110 (Opposed Blade)

B. General Requirements:

1. Unless otherwise indicated, use parallel-blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed-blade configuration.
2. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.

C. Performance:

1. AMCA Certification: Test and rate in accordance with AMCA 511.
2. Leakage:

    a. Class I: Leakage shall not exceed 8 cfm/sq. ft. against 4-inch wg differential static pressure.

3. Pressure Drop: Maximum 0.07-inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
4. Velocity: Up to 2000 fpm.
5. Temperature: Minus 25 to plus 150 deg F.
6. Pressure Rating: Low to medium pressure and velocity systems. Up to 4 in. wg pressure differential.

D. Construction:

1. Suitable for horizontal or vertical airflow applications.
2. Frames:

    a. Hat, U, or angle shaped.
    b. Material: Galvanized steel, minimum 16 gauge thick.
    c. Mitered and welded or interlocking, gusseted corners.
    d. Flanges for attaching to walls and flangeless frames for installing in ducts.

3. Blades:

    a. Multiple blade with maximum blade width of 4 to 6 inches.
    b. Type: 3V.
    c. Material: Galvanized steel.
    d. Thickness: Minimum 16 gauge.

4. Blade Edging Seals:

    a. Replaceable closed-cell neoprene, PVC, or thermoplastic elastomer (TPE).

5. Blade Jamb Seal: Flexible stainless steel, compression type.
6. Blade Axles: 1/2-inch diameter; plated or stainless steel.
7. Blade-Linkage Hardware: Zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of air stream.
8. Bearings:

    a. Molded synthetic.
    b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.

E. Damper Actuator - Electric:

1. Electric - 24 V ac.
2. UL 873, plenum rated.
3. Two position with fail-safe spring return.

    a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
    b. Minimum 90-degree drive rotation.

4. Clockwise or counterclockwise drive rotation as required for application.

5. Environmental Operating Range:

    a. Temperature: Minus 40 to plus 130 deg F.
    b. Humidity: 5 to 95 percent relative humidity noncondensing.

6. Environmental enclosure: NEMA 2.
7. Actuator to be factory mounted and provided with a single-point wiring connection.

2.4 LOUVERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Nailor Industries.
3. Ruskin Company.
4. United Enertech.

B. Stationary Louvers

1. Drainable blade.
2. Extruded aluminum frame and deep channels, mechanically fastened.
3. Minimum 50% free area.
4. Performance certified with AMCA 511 when tested in accordance with AMCA 500-L for water penetration and air performance. Airflow resistance at 1000 feet per minute free area intake velocity shall not be greater than 0.173 inch water gauge pressure drop. Airflow resistance at 1000 feet per minute free area exhaust velocity shall not be greater than 0.144 inch water gauge pressure drop. Beginning point of water penetration shall not be less than 1007 feet per minute free area intake velocity.
5. Louvers shall be designed and manufactured to withstand a minimum 25 pound per square foot wind load.
6. Options:

    a. Bird screens.
    b. Insect screens.
    c. Architectural finishes and colors.
    d. Flanged frame.
    e. Glazing frame.
    f. Welded construction.

2.5 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aire Technologies.
2. Arrow United Industries.
3. Cesco Products; a division of MESTEK, Inc.
4. CL WARD LLC.
5. Ductmate Industries, Inc.
6. Duro Dyne Inc.
7. Elgen Manufacturing.
8. Flexmaster U.S.A., Inc.

9. Greenheck Fan Corporation.
10. McGill AirFlow LLC.
11. Ruskin Company.
12. United Enertech.
13. Ward Industries; a brand of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."

1. Door:

   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. 24-gauge-thick galvanized steel door panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

   a. 24-gauge-thick galvanized steel or 0.032-inch-thick aluminum frame.

3. Number of Hinges and Locks:

   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches.
   d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.6 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD LLC.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. DynAir; a Carlisle Company.
5. Elgen Manufacturing.
6. Ventfabrics, Inc.
7. Ward Industries; a brand of Hart & Cooley, Inc.

B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Materials: Flame-retardant or noncombustible fabrics.

E. Coatings and Adhesives: Comply with UL 181, Class 1.

F. Metal-Edged Connectors: Factory fabricated with a fabric strip 3 inches wide attached to two strips of 3-inch-wide, 0.028-inch-thick (24 gauge), galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

G. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

H. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

I. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd.
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

2.7 DUCT ACCESSORY HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD LLC.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. DynAir; a Carlisle Company.
5. Elgen Manufacturing.
6. Hardcast; a Carlisle Company.
7. United Enertech.
8. Ventfabrics, Inc.
9. Ward Industries; a brand of Hart & Cooley, Inc.

B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.8 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.

C. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.

G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. At outdoor-air intakes and mixed-air plenums.
3. At drain pans and seals.
4. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
5. At each change in direction and at maximum 50-ft. spacing.
6. Upstream from turning vanes.
7. For grease ducts, install at locations and spacing as required by NFPA 96.
8. Control devices requiring inspection.
9. Elsewhere as indicated.

H. Install access doors with swing against duct static pressure.

I. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.

4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

J. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.
3. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.

END OF SECTION

SECTION 233346 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Insulated flexible ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

D. Comply with ASTM E96/E96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 INSULATED FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc. (1M)
2. H&C Flex Duct
3. Thermaflex; a Flex-Tek Group company. (M-KC)
4. Quietflex Manufacturing Company, L.P. (HPDFlex™)

B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; metalized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive, 1-inch wg negative.

2. Maximum Air Velocity: 5500 fpm.
3. Temperature Range: Minus 20 to plus 250 deg F.
4. Insulation R-Value: Comply with ASHRAE/IES 90.1.

2.3 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

B. Non-Clamp Connectors: Liquid adhesive plus tape or adhesive plus sheet metal screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

D. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

E. Connect flexible ducts to metal ducts with **liquid adhesive plus tape**, **draw bands**, or adhesive plus sheet metal screws.

F. Install duct test holes where required for testing and balancing purposes.

G. Installation:

1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.
3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.

H. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Ceiling-mounted ventilators.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
2. Rated capacities, operating characteristics, and furnished specialties and accessories.
3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Prefabricated roof curbs.
9. Fan speed controllers.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Design Calculations: Calculate requirements for selecting vibration isolators [**and seismic restraints**].

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 CEILING-MOUNTED VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing Corp.
2. American Coolair Corporation.
3. Broan-NuTone LLC.
4. CaptiveAire.
5. Carnes Company.
6. FloAire National.
7. Greenheck Fan Corporation.
8. JencoFan.
9. Loren Cook Company.
10. Panasonic Corporation of North America.
11. PennBarry.
12. S & P USA Ventilation Systems, LLC.

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel removable for service.

D. Back-draft damper: Integral.

E. Grille: Plastic, louvered grille with flange on intake and thumbscrew or spring retainer attachment to fan housing.

F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

PART 3 - EXECUTION

3.1 INSTALLATION OF HVAC POWER VENTILATORS

A. Install power ventilators level and plumb.

B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

C. Install units with clearances for service and maintenance.

3.2 DUCTWORK CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. 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.
2. Verify that there is adequate maintenance and access space.
3. Verify that cleaning and adjusting are complete.
4. Adjust damper linkages for proper damper operation.
5. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 233713.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Square ceiling diffusers.
2. Perforated diffusers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 SQUARE CEILING DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hart & Cooley Inc.
2. Krueger-HVAC, a division of Air System Components; Johnson Controls, Inc.
3. METALAIRE, Inc.
4. Nailor Industries Inc.
5. Price Industries.
6. Titus, a division of Air System Components; Johnson Controls, Inc.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel.

D. Pattern: Adjustable.

2.2 PERFORATED DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hart & Cooley Inc.
2. Krueger-HVAC, a division of Air System Components; Johnson Controls, Inc.
3. METALAIRE, Inc.
4. Nailor Industries Inc.
5. Price Industries.
6. Titus, a division of Air System Components; Johnson Controls, Inc.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel backpan and pattern controllers, with steel face.

D. Pattern Controller: None.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2 INSTALLATION

A. Install diffusers level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes gas-fired, fire-tube condensing boilers, trim, and accessories for generating hot water.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for boilers.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period. Where "prorated" is indicated, the boiler manufacturer will cover the indicated percentage of cost of replacement parts. With "prorated" type, covered cost decreases as age of equipment increases.

1. Warranty Period for Floor-Mounted Fire-Tube Condensing Boilers:

a. Heat Exchanger/Pressure Vessel: 10 year, non-prorated, free from defects in material and workmanship.
b. Burner: 5 years from shipment.
c. Thermal Shock: Lifetime.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency in accordance with Table 6.8.1-6 and other requirements in Ch. 6 of ASHRAE/IES 90.1.

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 431, Subpart E, Appendix N.

2.2 FLOOR-MOUNTED, FORCED-DRAFT, FIRE-TUBE CONDENSING BOILERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AERCO; A WATTS Brand.
2. Camus Hydronics.
3. Cleaver-Brooks.
4. Fulton Boiler Works, Inc.
5. Lochinvar, LLC.
6. Patterson-Kelley.
7. Viessmann; A Carrier Company.
8. Weil-McLain.

B. Description: Factory-fabricated, -assembled, and -tested, fire-tube, forced-draft, condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Units are to be for water-heating service only.

C. Primary Heat Exchanger: Corrosion-resistant stainless steel.

D. Secondary Heat Exchanger: Corrosion-resistant stainless steel.

E. Combustion Chamber and Flue Pipes: Corrosion-resistant stainless steel.

F. Pressure Vessel: Carbon steel with welded heads and tube connections.

G. Burner: Natural gas, forced draft.

H. Blower: Variable-speed, DC centrifugal fan to operate during each burner-firing sequence and to pre-purge and post-purge the combustion chamber.

1. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

a. Motor Sizes: Large enough so driven load will not require motor to operate in service factor range above 1.0.

I. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

J. Ignition: Direct-spark ignition or silicone carbide hot-surface ignition with 100 percent main-valve shutoff and electronic flame supervision.

K. Casing:

1. Jacket: Sheet metal and/or plastic, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Finish: Baked-enamel or powder-coated protective finish.
4. Combustion-Air Connections: Inlet and vent duct collars.

L. Exhaust Manifold:

1. Corrosion resistant cast aluminum or stainless steel.
2. Collecting reservoir and gravity drain for the elimination of condensation.

M. Combustion Air:

1. The boiler shall be designed such that the combustion air is drawn from the inside of the boiler enclosure, decoupling it from the combustion air supply and preheating the air to increase efficiency.

2.3 TRIM - FOR HOT-WATER BOILERS

A. Include devices sized to comply with ASME B31.1.

B. Safety Relief Valve: ASME rated.

C. Pressure and Temperature Gauge: Minimum 3-1/2-inch-diameter, combination water-pressure and -temperature gauge. Gauges shall have operating-pressure and -temperature ranges, so normal operating range is about 50 percent of full range.

D. High and low gas-pressure switches.

E. Alarm bell with silence switch.

F. Boiler Air Vent: Manual.

G. Condensate Drain Trap.

H. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

2.4 CONTROLS

A. Refer to temperature controls drawings for BAS input/output summary form and sequence of operations.

B. Boiler operating controls shall include the following devices and features:

1. Control transformer.
2. Set-Point Adjust: All set points shall be adjustable.

3. Electric, factory-fabricated and factory-installed panel to control burner-firing rate, to reset supply-water temperature inversely with outside-air temperature. At 0 deg F outside-air temperature, set supply-water temperature at 160 deg F; at 55 deg F outside-air temperature, set supply-water temperature at 130 deg F. Temperatures shall be adjustable.

    a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.

C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.
2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch factory mounted on boiler combustion-air inlet.
4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

D. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.

1. Hardwired Points:

    a. Monitoring: On/off status, common trouble alarm, low-water-level alarm.
    b. Control: On/off operation, hot-water-supply temperature set-point adjustment.

2. A BACnet communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. All monitoring and control features, which are available at the local boiler control panel, shall also be available at the remote operator workstation through the building automation system.

2.5 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are shown on Drawings and specified in electrical Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a raceway.
4. Field power interface shall be to interlock circuits, factory wired in the closed position using jumpers.
5. Provide branch power circuit to each motor and to controls.
6. Provide each motor with overcurrent protection.

2.6 VENTING AND COMBUSTION AIR

A. Combustion-Air Intake: Complete system with pipe, vent terminal with screen, inlet air coupling, and sealant.

B. Vent material shall be AL29-4C stainless steel or polypropylene, as acceptable by the manufacturer.

C. Comply with all boiler manufacturer's installation instructions.

2.7 CONDENSATE-NEUTRALIZATION UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Neutra-Safe Corporation.
2. SFA Saniflo USA.
3. Skidmore Pump.
4. Wessels Company.

B. Description: Factory-fabricated and -assembled condensate-neutralizing capsule assembly of corrosion-resistant plastic material with threaded or flanged inlet and outlet pipe connections. Device functions to prevent acidic condensate from damaging grain system. It is to be piped to receive acidic condensate discharged from condensing boiler and neutralize it by chemical reaction with replaceable neutralizing agent. Neutralized condensate is then piped to suitable drain.

C. Capsule features:

1. All corrosion-resistant material.
2. Suitable for use on all natural gas and propane boilers.
3. Includes initial charge of neutralizing agent.
4. Neutralizing agent to be easily replaceable when exhausted.
5. Inlet and outlet pipe connections.

D. Capsule Configuration:

1. Low-profile design for applications where boiler condensate drain is close to the floor.
2. Easily removed and opened for neutralizing agent replacement.
3. Multiple units may be used for larger capacity.

2.8 SOURCE QUALITY CONTROL

A. UL Compliance: Test gas-fired boilers having input of more than 400,000 Btu/h for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

B. UL Compliance, Gas-Fired: Test gas-fired boilers for compliance with UL 2764. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

C. CSA Compliance: Test boilers for compliance with ANSI Z21.13-2017/CSA 4.9.

D. Performance Testing: Test and label boilers for efficiency to comply with AHRI 1500.

E. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

F. Test and inspect factory-assembled boilers, before shipping, in accordance with 2017 ASME Boiler and Pressure Vessel Code. Factory test boilers for safety and functionality; fill boiler with water, and fire throughout firing range, to prove operation of all safety components.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

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

3.2 BOILER INSTALLATION

A. Install gas-fired boilers according to the International Fuels Gas Code.

B. Assemble and install boiler trim.

C. Install electrical devices furnished with boiler but not specified to be factory mounted.

D. Install control wiring to field-mounted electrical devices.

3.3 PIPING CONNECTIONS

A. Comply with requirements for hydronic piping specified in Section 232113 "Hydronic Piping."

B. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 232116 "Hydronic Piping Specialties."

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. When installing piping adjacent to boiler, allow space for service and maintenance of condensing boilers. Arrange piping for easy removal of condensing boilers.

E. Install condensate drain piping to condensate-neutralization unit and from neutralization unit to nearest floor drain. Piping shall be at least full size of connection. Install piping with a minimum of 2 percent downward slope in direction of flow.

F. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.

G. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve, and union or flange at each connection.

H. Install piping from safety relief valves to nearest floor drain.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative:

B. Tests and Inspections:

1. Perform installation and startup checks in accordance with manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
    b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Boiler will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers.

1. Instructor shall be factory trained and certified.
2. Provide not less than two hours of training.
3. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
5. Obtain Owner sign-off that training is complete.
6. Owner training shall be held at Project site.

END OF SECTION

SECTION 237223.29 - PACKAGED, OUTDOOR, FIXED PLATE ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fixed-plate, total heat exchangers in packaged, outdoor, energy-recovery units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include packaged, outdoor, fixed-plate, energy-recovery-unit rated capacities, operating characteristics, furnished specialties, and accessories.
2. Fans:

    a. Certified fan-performance curves with system operating conditions indicated.
    b. Certified fan-sound power ratings.
    c. Fan construction and accessories.
    d. Motor ratings, electrical characteristics, and motor accessories.

B. Shop Drawings: For packaged, outdoor, fixed-plate, energy-recovery units.

1. Include plans, elevations, sections, details, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, lifting requirements, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged, outdoor, fixed-plate, energy-recovery equipment to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate sizes and locations of building openings and duct connections with actual equipment provided.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, outdoor, fixed-plate, energy-recovery units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Packaged Energy-Recovery Units: One year from date of Substantial Completion.
2. Warranty Period for Fixed-Plate Heat Exchangers: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

B. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1.
2. Capacity ratings for fixed-plate energy-recovery units shall comply with ASHRAE 84.

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

D. UL Compliance:

1. Packaged heat-recovery ventilators shall comply with requirements in UL 1815 or UL 1812.

E. Comply with ASTM E84 or UL 723.

2.2 PACKAGED, OUTDOOR, FIXED-PLATE, TOTAL HEAT, ENERGY-RECOVERY UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Lifebreath; a division of Airia Brands.
3. Renewaire.
4. Venmar CES Inc.

B. Source Limitations: Obtain packaged, outdoor, fixed-plate, energy-recovery units from single manufacturer.

C. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1.

D. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, gasketed, hinged access doors or removable panels with neoprene gaskets for inspection and access to internal parts, minimum 1-inch thick, expanded polystyrene foam thermal insulation, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs.

E. Fixed-Plate, Heat Exchanger:

1. Casing: Aluminum.
2. Drain Pan: Same material as casing, with drain connections on exhaust and supply side.

    a. Comply with requirements in ASHRAE 62.1.

3. Plates: Evenly spaced, sealed, and arranged for cross-flow.

    a. Plate Material: Embossed aluminum.

F. Supply and Exhaust Fans: Forward-curved centrifugal fan with spring isolators of 1-inch static deflection.

1. Motors and Drives: Direct driven.

G. Filters:

1. Description: Cleanable wire mesh at outside air intake and pleated factory-fabricated, self-supported, disposable air filters with holding frames.
2. UL Compliance: Comply with UL 900.
3. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
4. Filter Media Frame: Beverage board with perforated metal retainer or metal grid on outlet side.
5. Filter-Mounting Frames: Arranged with access doors or panels on both sides of unit. Filters shall be removable from one side or lift out from access plenum.

H. Wiring: Fabricate units with space within housing for electrical conduits. Wire motors and controls so only external connections are required during installation.

1. Outdoor Enclosure: NEMA 250, Type 3R enclosure contains relays, starters, and terminal strip.
2. Include nonfused disconnect switches.

2.3 CONTROLS

A. Control Panel: Solid-state, programmable, microprocessor-based control unit for wall mounting. Integrate to BACnet, LonWorks, or Modbus, as specified in Section 230923 "Building Automation Controls."

B. Starting relay, factory mounted and wired, and manual motor starter for field wiring.

C. Dry-bulb temperature sensor.

D. Dirty filter switch.

E. Low-Voltage Transformer: Integral transformer to provide control voltage to unit from primary incoming electrical service.

2.4 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by NRTL, and marked for intended location and application.

B. AHRI Compliance: Capacity ratings for air-to-air energy-recovery equipment certified as complying with AHRI 1060 (IP).

C. Fan Performance Rating: Comply with AMCA 211, and label fans with AMCA-certified rating seal. Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency in accordance with AMCA 210 and ASHRAE 51.

D. Fan Sound Ratings: Comply with AMCA 301 or AHRI 260 (IP).

E. UL Compliance:

1. Packaged, Fixed-Plate, Energy-Recovery Units: Comply with requirements in UL 1812.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before packaged, outdoor, fixed-plate, energy-recovery unit installation. Replace insulation materials and filter media that are wet, moisture damaged, or mold damaged.

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

3.2 INSTALLATION OF PACKAGED, OUTDOOR, FIXED-PLATE, ENERGY-RECOVERY UNITS

A. Install packaged, outdoor, fixed-plate, energy-recovery units, so supply and exhaust airstreams flow in opposite directions.

1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to interior components.
2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
3. Access doors and panels are specified in Section 233300 "Air Duct Accessories."

B. Install units with clearances for service and maintenance.

C. Do not operate equipment fans until temporary or permanent filters are in place. Replace temporary filters used during construction and testing with new, clean filters prior to final inspection.

3.3 DUCTWORK CONNECTIONS

A. Comply with requirements for ductwork in accordance with Section 233113 "Metal Ducts."

B. Connect duct to units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

3.4 ELECTRICAL CONNECTIONS

A. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.6 STARTUP SERVICE

A. Engage factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.

3.7 ADJUSTING

A. Adjust moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature and humidity setpoints.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections with assistance of factory-authorized service representative.

B. Tests and Inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Packaged, outdoor, fixed-plate, energy-recovery units will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy-recovery units.

END OF SECTION

SECTION 237416 - PACKAGED ROOFTOP AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes packaged, large-capacity, rooftop air conditioning units (RTUs) with the following components:

1. Casings.
2. Fans, drives, and motors.
3. Coils.
4. Refrigerant circuit components.
5. Air filtration.
6. Gas furnaces.
7. Dampers.
8. Electrical power connections.
9. Controls.
10. Roof curbs.
11. Accessories.

1.3 DEFINITIONS

A. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, large-capacity, rooftop air-conditioning units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

1.4 ACTION SUBMITTALS

A. Product Data: For each RTU.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
3. Include unit dimensions and weight.
4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
5. Fans:

    a. Include certified fan-performance curves with system operating conditions indicated.
    b. Include certified fan-sound power ratings.
    c. Include fan construction and accessories.
    d. Include motor ratings, electrical characteristics, and motor accessories.

6. Include certified coil-performance ratings with system operating conditions indicated.

7. Include filters with performance characteristics.
8. Include gas furnaces with performance characteristics.
9. Include factory selection calculations for each antimicrobial ultraviolet lamp installation.
10. Include dampers, including housings, linkages, and operators.

B. Shop Drawings: For each packaged, large-capacity, rooftop air-conditioning units.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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.

1.7 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of outdoor, semi-custom, air-handling unit that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.
2. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of RTUs and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE 15 Compliance: For refrigeration system safety.

E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. UL Compliance: Comply with UL 1995.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. AAON.
2. CaptiveAire Systems.
3. Carrier Corporation.
4. Daikin Applied.
5. Trane.
6. YORK; a Johnson Controls company.

2.3 UNIT CASINGS

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Double-Wall Construction:

1. Outside Casing Wall: Galvanized steel, minimum 22 gauge thick with manufacturer's standard finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
2. Inside Casing Wall: G90-coated galvanized steel.
3. Floor Plate: G90 galvanized steel.
4. Casing Insulation:

    a. Materials: Injected polyurethane foam insulation.
    b. Casing Panel R-Value: 13.
    c. Insulation Thickness: 2 inches.
    d. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roof of unit.

C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

D. Static-Pressure Classifications +/- 6” w.c.

E. Panels and Doors:

1. Panels:

    a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
    b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
    c. Gasket: Neoprene, applied around entire perimeters of panel frames.
    d. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components

2. Access Doors:

    a. Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
    b. Gasket: Neoprene, applied around entire perimeters of panel frames.
    c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.

F. Condensate Drain Pans:

1. Location: Each type of cooling coil.
2. Construction:

    a. Single-wall, stainless steel sheet.

3. Drain Connection:

    a. Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

4. Slope: Minimum 0.125-in./ft. slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
5. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.
6. Width: Entire width of water producing device.
7. Depth: A minimum of 2 inches deep.
8. Pan-Top Surface Coating for Galvanized-Steel Drain Pans: Asphaltic waterproofing compound.
9. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.4 FANS, DRIVES, AND MOTORS

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.

B. Supply-Air Fans: Centrifugal, rated according to AMCA 210; galvanized or painted steel; mounted on solid-steel shaft.

1. Shafts: With field-adjustable alignment.

    a. Turned, ground, and polished hot-rolled steel with keyway.

2. Shaft Bearings:

    a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours according to ABMA 9.

3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.

4. Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; steel or aluminum hub swaged to backplate and fastened to shaft with setscrews.
5. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
6. Shaft Lubrication Lines: Extended to a location outside the casing.
7. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches wide, attached to two strips of minimum 2-3/4-inch-wide by 0.028-inch-thick, galvanized-steel sheet.

a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.

C. Relief-Air Fan: Backward inclined plenum fan, shaft mounted on permanently lubricated motor.

D. Drives, Direct: Factory-mounted, direct drive.

E. Condenser-Coil Fan: Variable-speed propeller, mounted on shaft of permanently lubricated ECM motors.

F. Motors:

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Enclosure Type: Open, dripproof.
3. Enclosure Materials: Cast iron.
4. Efficiency: Premium efficient as defined in NEMA MG 1.
5. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.5 COILS

A. General Requirements for Coils:

1. Comply with AHRI 410.
2. Fabricate coils section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils shall not act as structural component of unit.

B. Supply-Air Refrigerant Coil:

1. Tubes: Copper.
2. Fins:

a. Material: Copper.
b. Fin Spacing: Maximum 12 fins per inch.

3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Frames: Galvanized steel.

6. Coatings: None.
7. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

    a. Working Pressure: Minimum 300 psig.

2.6 REFRIGERANT CIRCUIT COMPONENTS

A. Compressor: Hermetic, variable speed scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

B. Refrigeration Specialties:

1. Refrigerant: R-32 or R-454B.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.

2.7 AIR FILTRATION

A. Panel Filters:

1. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
2. Filter Unit Class: UL 900.
3. Media: Interlaced glass, synthetic or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
4. Filter-Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.

2.8 GAS FURNACES

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47/CSA 2.3 and the International Fuel Gas Code.

B. CSA Approval: Designed and certified by and bearing label of CSA.

C. Burners: Stainless steel.

1. Rated Minimum Turndown Ratio: Refer to plans.
2. Fuel: Natural gas.
3. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
4. Gas Control Valve: Modulating.
5. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

D. Heat-Exchanger and Drain Pan: Stainless steel.

E. Venting, Power: Power vented, with integral, motorized centrifugal fan interlocked with gas valve.

F. Safety Controls:

1. Gas Manifold: Safety switches and controls complying with ANSI standards.

2.9 DAMPERS

A. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel or aluminum dampers with compressible jamb seals and extruded-vinyl or rubber blade edge seals in parallel-blade arrangement with steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 4 cfm/sq. ft. at 1-inch wg and 8 cfm/sq. ft. at 4-inch wg.

2.10 ELECTRICAL POWER CONNECTIONS

A. RTU shall have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.11 CONTROLS

A. Basic Unit Controls:

1. Control-voltage transformer.
2. Wall-mounted thermostat or sensor with the following features:

a. Heat-cool-off switch.
b. Fan on-auto switch.
c. Fan-speed switch.
d. Manual changeover.
e. Adjustable deadband.
f. Exposed set point.
g. Exposed indication.
h. Degree F indication.
i. Unoccupied-period-override push button.

B. DDC Controller:

1. Controller shall have volatile-memory backup.
2. Safety Control Operation:

a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
b. Fire Alarm Control Panel Interface.
c. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 deg F.
d. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.

3. Scheduled Operation: 365 day clock with a minimum of four programmable periods per day.

C. Interface Requirements for HVAC Instrumentation and Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet compatible interface for central HVAC control workstation for the following:

a. Adjusting set points.
b. Monitoring supply fan start, stop, and operation.
c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature.
d. Monitoring occupied and unoccupied operations.
e. Monitoring constant and variable motor loads.
f. Monitoring variable-frequency drive operation.
g. Monitoring cooling load.
h. Monitoring economizer cycles.
i. Monitoring air-distribution static pressure and ventilation air volume.

2.12 ROOF CURBS

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

a. Materials: ASTM C1071, Type I or II.
b. Thickness: 1 inch.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

a. Liner Adhesive: Comply with ASTM C916, Type I.
b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
d. Liner Adhesive: Comply with ASTM C916, Type I.

B. Curb Dimensions: Height of 24 inches.

2.13 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Factory- or field-installed demand-controlled ventilation.

C. Safeties:

1. Smoke detector.
2. Condensate overflow switch.
3. Phase-loss protection.
4. High and low pressure control.
5. Gas furnace airflow-proving switch.

D. Hail guards of galvanized steel, painted to match casing.

E. Outdoor air intake weather hood.

2.14 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B209.

2.15 SOURCE QUALITY CONTROL

A. AHRI Compliance:

1. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
2. Comply with AHRI 210/240 for testing and rating energy efficiencies for RTUs
3. Comply with AHRI 270 for testing and rating sound performance for RTUs.

B. AMCA Compliance:

1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
2. Damper leakage tested in accordance with AMCA 500-D.
3. Operating Limits: Classify according to AMCA 99.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

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

3.2 INSTALLATION

A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "NRCA Roofing Manual: Membrane Roof Systems." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing with anchor bolts. Coordinate sizes and locations of roof curbs with actual equipment provided.

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to RTU, allow space for service and maintenance.

C. Connect piping to unit mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using NPS 1-1/4, ASTM B88, Type M copper tubing. Extend to nearest equipment or roof drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

3.4 DUCT CONNECTIONS

A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of 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 RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.

3.5 ELECTRICAL CONNECTIONS

A. Connect electrical wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

3.6 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.7 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.

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.

17. Inspect and record performance of interlocks and protective devices; verify sequences.
18. Operate unit for an initial period as recommended or required by manufacturer.
19. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.

    a. Measure gas pressure on manifold.
    b. Inspect operation of power vents.
    c. Measure combustion-air temperature at inlet to combustion chamber.
    d. Measure flue-gas temperature at furnace discharge.
    e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

20. Calibrate thermostats.
21. Adjust and inspect high-temperature limits.
22. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.

23. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

24. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
25. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

26. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

27. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. High-temperature limit on gas-fired heat exchanger.
    b. Low-temperature safety operation.
    c. Filter high-pressure differential alarm.
    d. Economizer to minimum outdoor-air changeover.
    e. Relief-air fan operation.
    f. Smoke and firestat alarms.

28. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.8 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.9 CLEANING

A. After completing system installation and testing, adjusting, and balancing RTUs and air-distribution systems and after completing startup service, clean RTUs internally to remove

foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing RTUs 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. RTU will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes split-system air-conditioning units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: 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. Shop Drawings: 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.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.6 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.7 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. For Compressor: Minimum five years from date of Substantial Completion.
b. For Parts: Minimum five years from date of Substantial Completion.
c. For Labor: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation.
2. Daikin.
3. Lennox Industries, Inc.; Lennox International.
4. Trane.
5. YORK; a Johnson Controls company.

2.2 OUTDOOR UNITS

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, 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.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

a. Compressor Type: Scroll.
b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
c. Refrigerant: R-454B or R32.
d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

3. Fan: Aluminum-propeller type, directly connected to motor.
4. Motor: Permanently lubricated, with integral thermal-overload protection.
5. Mounting Base: Polyethylene.

2.3 ACCESSORIES

A. Automatic-reset timer to prevent rapid cycling of compressor.

B. 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.

C. Drain Hose: For condensate.

D. Monitoring:

1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.
3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 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. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 238223 - UNIT VENTILATORS (TALL CABINET TYPE)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes self-contained, tall-cabinet-type unit ventilators and accessories with the following heating and cooling features:

1. Hydronic heating coil.
2. Direct-expansion refrigerant cooling coil.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product

1. Include rated capacities, operating characteristics, and furnished specialties and accessories for each unit type and configuration.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail anchorages and attachments to structure and to supported equipment.
4. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For unit ventilators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Unit Ventilator Filters: Furnish one spare filter for each filter installed.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.7 COORDINATION

A. Coordinate layout and installation of unit ventilators with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate size and location of wall sleeves for outdoor-air intake.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: All components, two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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. Factory-packaged and -tested units rated according to AHRI 840, ASHRAE 33, and UL 1995.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Airedale; a subsidiary of Modine Manufacturing Company.
2. Carrier Corporation.
3. Changeair; a Systemair Company.
4. Daikin Applied.
5. Trane.

2.3 MANUFACTURED UNITS

A. Description: Unit ventilators consisting of finished cabinet, filter, hydronic heating coil, drain pan, supply-air fan and motor in blow- or draw-through configuration, and self-contained DX refrigerant cooling coil.

2.4 CABINETS

A. Insulation: Minimum 1-inch-thick, acoustic polyester/polyurethane closed-cell foam with density of 2-pounds per cubic foot containing no fibrous materials complying with ASTM C1071 and attached with adhesive complying with ASTM C916.

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E84 by a qualified testing agency.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
3. Insulate all outside air plenums with a minimum of 1” duct liner when not furnished pre-insulated from the manufacturer. Insulation shall be installed in such a manner as to provide complete thermal isolation of all outside air surfaces from other portions of the equipment.

B. Acoustic package: unit to be constructed with multi-layered premium foam insulation with barrier, and revised airflow paths to maximize acoustic dampening.

C. Coil Section Insulation:

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E84 by a qualified testing agency.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Main and Auxiliary Drain Pans: Stainless steel, formed as required by ASHRAE 62.1.

E. Cabinet Frame and Access Panels: Welded-steel frame with removable panels fastened with hex-head tamperproof fasteners.

F. Cabinet Finish: Powder coat, in manufacturer's standard color as selected by Architect.

G. Outdoor-Air Wall Box: Existing.

H. Access door is factory installed on the front of the unit. Door interior shall be fully insulated to provide for superior noise deadening at front of unit. Door shall employ heavy duty ¼” zinc plated steel plunger hinges with a spring-loaded ¼” zinc plated steel pin to allow for easy removal, if required. Door is secured with two (2) key locks. Door swing designed to turn into itself allowing side of the unit to be installed directly against a wall in the corner of a room.

I. Condensate Connection: Factory installed condensate connection stub provided for connection to the field installed building condensate drain. Tube dimensions 3/4" ID, 1" OD.

2.5 COILS

A. Test and rate unit ventilator coils according to ASHRAE 33.

B. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

C. Indoor Refrigerant Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and brazed joints at fittings. Comply with AHRI 210/240, and leak test to minimum 450 psig for a minimum 300-psig working pressure. Include thermal expansion valve.

2.6 FANS AND MOTORS

A. The indoor fan assembly consists of one blower inside teardrop housing assembly engineered specifically for optimal airflow with low noise and minimal power consumption. Blower is powered by electronically commutated motor (ECM). The DC motor features brushless, permanently lubricated ball bearing construction for maintenance free operation. A wide range of programmable speeds and torque characteristics is possible for ultra-high efficiency and low audible noise. The ECM provides constant airflow by automatically adjusting the speed if the external static pressure changes. Electrical and control wiring to fan assembly includes quick disconnect plug local to assembly.

B. Outdoor (Condenser) Fan Assembly: The outdoor fan assembly consists of one backward curved plug fan with centrifugal blower wheel powered by an electronically commutated motor (ECM). The DC motor features brushless, permanently lubricated ball bearing construction for maintenance free operation. A wide range of programmable speeds and torque characteristics are possible for ultra-high efficiency and low audible noise. Fan design capable of overcoming external static pressures brought on by rear extensions backs and duct work connected to the fan discharge opening. Fan is sized such that powered relief shall be integral to the unit to prevent over pressurization of the space when the unit is introducing outside air. Capable of relieving 100% equivalent of the fresh air intake of the unit. Electrical and control wiring to fan assembly includes quick disconnect plug local to assembly.

2.7 DAMPERS

A. Mixing Dampers: Galvanized-steel blades with edge and end seals and nylon bearings; with electric actuator.

B. Outdoor-Air Dampers: Galvanized-steel blades with edge and end seals and nylon bearings; with electric actuator.

C. Comply with ASHRAE/IES 90.1.

2.8 CONTROL PANEL

A. Control Panel: Located at top of the unit behind the front door for direct, centrally located access to controller, controller transformer (24V), and all necessary contactors, relays, and circuit breakers.

B. Wiring: Individually numbered terminal blocks and wires are to match job-specific wiring diagrams. All electrical wires in the control panel will run in an enclosed trough. Wiring outside the control panel to be contained in a protective sleeve. All controls and wiring is factory installed in a clean, organized arrangement.

C. Plug and Socket Wiring: Supply and relief fan decks, compressor, damper assembly, and energy wheel assembly (if applicable) wiring includes plugs local to the assembly allowing for quick wiring disconnect when the component requires removal for service.

2.9 CONTROLS

A. The unit is fitted with a programmable microprocessor controller provided by the unit manufacturer mounted outside the air stream in the control panel. The controller is designed specifically for operating the unit in its most energy efficient manner using pre-engineered control strategies. The microprocessor determines mode of operation based on the factory installed return air and supply air temperature sensors.

B. The factory Microprocessor Control includes integral compatibility with a BACnet MS/TP control system.

C. Factory installed controls shall enable the unit to operate in the following modes:

1. If occupancy control is to be initiated by contact closure by others, the contact must be a dry contact only.
2. Free Cooling – using outside air in favorable conditions
3. Stage One Mechanical Cooling: 67% capacity compressor, low speed supply fan, reversing valve closed
4. Stage Two Mechanical Cooling: Controller adjusts compressor capacity and supply fan speed based on load conditions through a sequence that is proprietary to Modine Controls, reversing valve closed
5. Stage Three Mechanical Cooling: 100% capacity compressor, high speed supply fan, reversing valve closed

D. The microprocessor controller shall also modify the minimum damper position to compensate for mode of operation and fan speed.

E. Wall Mounted Digital Thermostat: Digital touchscreen thermostat used in conjunction with the Factory Microprocessor Control displays current room temperature, CO2 levels, cooling and heating setpoints, warmup time, occupancy override time as well as fan, unit, cooling, heating and dehumidification statuses. The display will also display a remote alarm from the Microprocessor Control. Thermostat allows for occupied temperature set-point adjustment. The allowable set-point adjustment range can be limited by the Microprocessor Control. Thermostat allows for occupied override activation allowing user to select the amount of time the unit is to remain in the override state. Thermostat mounted remote from the unit.

2.10 HOT WATER HEATING

A. Hot Water Coil (unit mounted): Unit is equipped with a one row hot water heating coil integral to the unit mounted in the reheat position relative to the evaporator coil. The coil is manufactured from refrigeration quality copper tubing mechanically bonded onto aluminum fins. Coil is fitted with both an air bleed and a drain plug.

2.11 ADDITIONAL FACTORY INSTALLED OPTIONS

A. Disconnect Switch: A power disconnect switch sized for the full load amperage of the unit. Allows the unit to be disconnected from the power supply prior to any maintenance. In the off position the switch can be locked out.

2.12 FIELD INSTALLED ACCESSORIES

A. Outside Air Rear Extension: Where site conditions do not permit the use of the standard locations for outside air intake and relief air discharge, an insulated outside air rear extension is supplied for site installation between the back of the unit and the outside wall by the mechanical contractor. The outside air rear extension is 10" deep and with adjustable panels.

B. Duct Shroud: Three sided duct shroud field mounted on top of the unit for extending the cabinet through the ceiling/soffit. Field trimmed by the installing contractor to suit the ceiling height. Finished and painted to match the unit.

C. Supply Air Replacement Filters: The unit shall be provided with set(s) of MERV 8 supply air replacement filters (Qty of 2).

D. Outdoor Coil Replacement Filter: The unit shall be provided with a MERV 8 outdoor coil replacement filter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, to receive unit ventilators for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit ventilator installation.

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

3.2 INSTALLATION

A. Install unit ventilators to comply with NFPA 90A.

B. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above finished floor.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect piping to unit ventilator factory hydronic piping package. Install piping package if shipped loose.
3. Connect condensate drain to indirect waste.

B. Connect supply-air and return-air ducts to unit ventilators with flexible duct connectors specified in Section 233300 "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain unit ventilators.

END OF SECTION

SECTION 238223 - UNIT VENTILATORS (VERTICAL, UNDER-THE-WINDOW TYPE)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes under-the-window type unit ventilators and accessories with the following heating features:

1. Hydronic heating coil.

B. Related Requirements:

1. Section 230500 “Common Work Results for HVAC.”
2. Section 230719 “HVAC Piping Insulation.”
3. Section 232113 “Hydronic Piping.”
4. Section 232116 “Hydronic Piping Specialties.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product

1. Include rated capacities, operating characteristics, and furnished specialties and accessories for each unit type and configuration.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail anchorages and attachments to structure and to supported equipment.
4. Include diagrams for power, signal, and control wiring

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For unit ventilators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Unit Ventilator Filters: Furnish one spare filter for each filter installed.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.

1. Warranty Period Parts: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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. Factory-packaged and -tested units rated according to AHRI 840, ASHRAE 33, and UL 1995.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation.
2. Daikin Applied.
3. Trane.

2.3 MANUFACTURED UNITS

A. Description: Unit ventilators consisting of finished cabinet, filter, heating coil, drain pan, and supply-air fan and motor in blow- or draw-through configuration.

2.4 CABINETS

A. Insulation: Minimum 1/2-inch-thick, coated glass fiber complying with ASTM C1071 and attached with adhesive complying with ASTM C916.

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E84 by a qualified testing agency.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
3. Insulate all outside air plenums with a minimum of 1” duct liner when not furnished pre-insulated from the manufacturer. Insulation shall be installed in such a manner as to provide complete thermal isolation of all outside air surfaces from other portions of the equipment.

B. Coil Section Insulation:

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E84 by a qualified testing agency.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Main and Auxiliary Drain Pans: Non-corrosive, formed as required by ASHRAE 62.1. Drain pans shall be removable.

D. Cabinet Frame and Access Panels: Welded-steel frame with removable panels fastened with hex-head tamperproof fasteners.

E. Cabinet Finish: Powder coat, in manufacturer's standard color as selected by Architect.

F. Indoor-Supply-Air Grille: Angled steel.

G. Return-Air Inlet: Front toe space.

H. End Panels: Matching material and finish of unit ventilator.

I. Outdoor-Air Wall Box: Existing.

2.5 COILS

A. Test and rate unit ventilator coils according to ASHRAE 33.

B. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

2.6 INDOOR FAN

A. Fan and Motor Board: Removable.

1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Fan Shaft and Bearings: Hollow-steel shaft with permanently lubricated, resiliently mounted bearings.
3. Motor: Permanently lubricated, multispeed, resiliently mounted on motor board.
4. Wiring Termination: Connect motor to chassis wiring with plug connection.

2.7 DAMPERS

A. Mixing Dampers: Galvanized-steel blades with edge and end seals and nylon bearings; with electric actuator.

B. Outdoor-Air Dampers: Galvanized-steel blades with edge and end seals and nylon bearings; with electric actuator.

C. Face and Bypass Dampers: Galvanized-steel damper blades with edge and end seals and nylon bearings; with factory-mounted electric actuator.

D. Comply with ASHRAE/IES 90.1.

2.8 ACCESSORIES

A. Insulated false back with gasket seals on wall and outdoor-air plenum.

1. Insulation: Minimum 1-inch-thick, coated glass fiber complying with ASTM C1071 and attached with adhesive complying with ASTM C916.

    a. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E84 by a qualified testing agency.
    b. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Filters: MERV 8

2.9 BASIC UNIT CONTROLS

A. Basic Unit Controls:

1. Control voltage transformer.
2. Wall-mounting thermostat with the following features.

    a. Heat-cool-off switch.
    b. Fan on-auto switch.
    c. Fan-speed switch.
    d. Manual changeover.
    e. Adjustable deadband.
    f. Exposed set point.
    g. Exposed indication.
    h. Degree F indication.

3. Unoccupied-period-override push button.
4. Data entry and access port.

    a. Input data includes room temperature, and humidity set points and occupied and unoccupied periods.
    b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

B. DDC Terminal Controller.

C. Building Automation System (BAS) Interface.

D. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, to receive unit ventilators for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit ventilator installation.

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

3.2 INSTALLATION

A. Install unit ventilators to comply with NFPA 90A.

B. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above finished floor.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping within dedicated end compartments to allow service and maintenance.
2. Connect condensate drain to indirect waste.

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain unit ventilators.

END OF SECTION

SECTION 238239.13 - CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes cabinet unit heaters with centrifugal fans and hot-water coils.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include location and size of each field connection.
4. Include details of anchorages and attachments to structure and to supported equipment.
5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
6. Indicate location and arrangement of piping valves and specialties.
7. Indicate location and arrangement of integral controls.
8. Wiring Diagrams: Power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Airtherm; a Mestek company.
2. Modine Manufacturing Company.
3. Trane.

2.2 DESCRIPTION

A. Factory-assembled and -tested unit complying with AHRI 440.

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. Comply with UL 2021.

2.3 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 COIL SECTION INSULATION

A. Insulation Materials: Comply with NFPA 90A. Closed-cell, preformed sheet insulation complying with ASTM C534, Type II, except for density.

1. Thickness: Minimum 1/4 inch
2. Thermal Conductivity (k-Value): 0.24 Btu x in./h x sq. ft. at 75 deg F mean temperature.
3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C411.
4. Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.5 CABINETS

A. Material: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.

1. Chassis: Minimum 0.0478-inch-thick (18 gauge).
2. Vertical Unit, Exposed Front Panels: Minimum 0.0598-inch-thick (16 gauge) sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
3. Recessed Flanges: Steel, finished to match cabinet.
4. Control Access Door: Key operated, 20 gauge thick.
5. Extended Piping Compartment: 8-inch-wide piping end pocket.

2.6 FILTERS

A. Minimum Efficiency Reporting Value and Average Arrestance: According to ASHRAE 52.2.

2.7 COILS

A. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

2.8 CONTROLS

A. Fan and Motor Board: Removable.

1. Fan: Forward curved, double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board.
3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

B. Basic Unit Controls:

1. Control voltage transformer.
2. Wall-mounted thermostat with the following features:

a. Heat-off switch.
b. Fan on-auto switch.
c. Manual fan-speed switch.
d. Adjustable deadband.
e. Exposed set point.
f. Exposed indication.
g. Deg F indication.

3. Unoccupied period override push button.

C. Interface with DDC System for HVAC Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at central workstation.
3. Interface shall be BAC-net compatible for central DDC system for HVAC workstation and include the following functions:

a. Adjust set points.
b. Cabinet unit-heater start, stop, and operating status.
c. Data inquiry, including supply-air and room-air temperature.
d. Occupied and unoccupied schedules.

D. Electrical Connection: Factory-wired motors and controls for a single field connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.

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

3.2 INSTALLATION

A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."

B. Install cabinet unit heaters to comply with NFPA 90A.

C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

D. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 232113 "Hydronic Piping," and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Section 233300 "Air Duct Accessories."

D. Comply with safety requirements in UL 1995.

E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of cabinet unit heater. Hydronic specialties are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."

F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION

SECTION 238323 - RADIANT-HEATING ELECTRIC PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes prefabricated radiant-heating electric panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For electric heating panels.

1. Include plans, sections, details, and attachments to other work.
2. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric heating panels to include in operation and maintenance manuals.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace electric heating panels that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR RADIANT-HEATING ELECTRIC PANELS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PREFABRICATED RADIANT-HEATING ELECTRIC PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berko; Marley Engineered Products.
2. QMark; Marley Engineered Products.
3. SSHC, Inc.

B. Description: Sheet-metal-enclosed panel with heating element suitable for recessed mounting. Comply with UL 2021.

1. Panel: Galvanized sheet steel back panel riveted to galvanized sheet steel front panel with fused-on crystalline surface.
2. Heating Element: Powdered graphite sandwiched between sheets of electric insulation.
3. Heating Element: Insulated resistive wires.
4. Electrical Connections: Nonheating, high-temperature, insulated-copper leads, factory connected to heating element.
5. Exposed-Side Panel Finish: Apply silk-screened finish to match appearance of Architect-selected acoustical ceiling tiles.

C. Wall Thermostat: Bimetal, sensing elements calibrated from 55 to 90 deg F; with contacts suitable for line-voltage circuit, and manually operated on-off switch with contactors, relays, and control transformers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive electric heating panels for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Ensure surfaces in contact with electric heating panels are free of burrs and sharp protrusions.
2. Ensure surfaces and substrates are level and plumb.

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

3.2 INSTALLATION

A. Install radiant-heating panels level and plumb.

B. Verify locations of thermostats with Drawings and room details before installation. Install devices 48 inches above finished floor.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operate electric-heating elements through each stage to verify proper operation and electrical connections.
2. Test and adjust controls and safeties.

B. Radiant-heating electric panels will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 PROTECTION

A. Protect installed radiant-heating electric panels from damage during construction.

B. Remove and replace damaged radiant-heating electric panels.

END OF SECTION

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SECTION 26 00 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Basic electrical Requirements specifically applicable to Division 26, 27 & 28 Sections, in addition to Division 1 - General Requirements.

B. Information in this section is intended to clarify or make additions to the requirements set forth in the General Conditions, Supplementary Conditions and Division 1 of these specifications. Any conflict between Division 26, 27 & 28 and those in the General Conditions or within the Division 26 drawings, Supplementary Conditions and Division 1 shall be brought to the attention of the Architect/Engineer in writing as a request for addendum prior to the bid opening.

C. Furnish all equipment, materials, articles, items, operations or methods listed, mentioned or scheduled on drawings, these specifications, manufacturer's installation instructions and include all labor materials, equipment and incidentals necessary for complete installation and operation.

D. All information contained in this section applies to all sections within Division 26 as it was part of each section.

E. Final walk-thru. Electrical Contractor shall submit in writing to the Architect's office or the Construction Manager advising that all of the Division 26, 27 & 28 work has been completed in accordance with the plans and specifications. The intent is to acknowledge the Contractor is ready for a walk-thru. Open items that are part of the required construction work should be completed prior to the final walk-thru to avoid developing a so called construction completion list. The engineer reserves the right to reschedule the final walk-thru as determined accordingly.

F. Pre-bid questions. All pre-bid questions, clarifications, etc. must be submitted in writing to the Architect Office or the Construction Manager. All phone calls, faxes or e-mails from bidders and manufacturers, etc. directly received by the Engineers office during the bidding phase will be deferred back to the Architect Office or the Construction Manager.

G. Electrical Contractor shall review all of the project plans and specifications and not rely solely on the electrical drawings to establish a project bid. Refer to the structural and mechanical drawings for final mechanical equipment locations. Mechanical drawings shall govern over the electrical drawing locations.

H. Unit Pricing: Contractor shall furnish pricing as listed in the Bid Proposal Forms.

I. The Contractor shall include in their bid any cost for requesting AutoCAD backgrounds for their use from the Architect or Engineer. The cost will be $150.00 for the first plan, and $50.00 for each additional plan that may be requested for

AutoCAD use. A waiver of responsibility for the Architect and Engineer related to Contractor use of the CAD files shall be signed by the Contractor.

1.2 LAYOUT OF THE WORK

A. Examine the site and all the drawings before proceeding with the layout and installation of this work. Verify all door swings and clearances to cabinets, etc., before locating switch and outlet boxes. Locate conduit, boxes, etc., essentially as shown on the drawings but in exact layout determined on the job to suit actual conditions. Confer and cooperate with the other trades on the job so all parts will be installed in proper relationship. Precise locations of parts to coordinate with other work is the responsibility of the Contractor.

B. The Electrical Trades shall complete all cutting and patching for the electrical work, unless noted or specified otherwise. Division 26, 27 & 28 Contractor shall be responsible to coordinate with the site Restoration Contractor for the new underground electrical work.

C. Arrange exposed work as closely as practicable to wall or ceiling surfaces in an accurate alignment. Locate concealed work so fittings, connectors and other projections will clear surfaces. Exposed work is defined as non-finished spaces, such as mechanical/electrical rooms or as indicated on architectural room schedules. All finished spaces, installation shall be concealed. Refer to Architectural drawing for room finish schedules.

D. During the bidding phase, if any design or discrepancy issues are discovered between the electrical drawings, specifications and other project plans, the contractor shall notify the Architect/Engineer. The intent is to resolve any issues during the bidding phase. For pertinent issues, addendums will be issued accordingly. After entering into a contract, it shall be considered there are no identified conflicts.

E. No drilling of existing laminated beams for new work is permitted without review with the project Structural Engineer

1.3 INTERFERENCES

A. The Electrical Contractor shall examine the plans of mechanical trades, the architectural and structural drawings and shall notify the Architect/Engineer to resolve such interference or discrepancy. The Electrical Contractor bid shall not be based solely on the Electrical Plans and Specifications. Contractor shall obtain and review all project documents. The Contractor, when directed, shall make such changes or off-sets as required so that the work shall be properly located and coordinated with the other trades. Failure to comply with the foregoing will not relieve contractor’s responsibilities of making such changes. Such changes shall be completed at no additional cost to the Owner.

B. All changes in location of equipment, fixtures, distribution equipment, receptacles, etc., from those shown on plans, shall be made without charge when directed by the Architect/Engineer before installation. At this time, an agreement shall be made if such a change is an additional cost to the owner.

C. The Electrical Contractor shall confer with other trades regarding location and size of pipes, equipment, fixtures, conduit, duct openings, switches, outlets, etc., in order that there may be no interference in the installation of the work of any trades or delay in the progress of any work.

D. The Electrical Contractor shall be responsible for confirming final receptacle, data, and switch heights at countertop and casework locations with the architectural details. Architectural details shall govern final locations and mounting heights. Failure to coordinate will not relieve the contractor of making changes as required, at no cost to the owner.

E. Any changes made, necessary through failure to make proper arrangement to avoid interference, shall not be considered as extra.

F. The Electrical Contractor shall cooperate with those performing work under other divisions in his preparation of interference drawings, to the extent that the location of plumbing piping, heating piping, and/or ventilation ducts, with respect to the installation of other trades, shall be mutually agreed on by those performing work under other divisions.

G. In the event the described work on the drawings doesn't match requirements described in the specification, the more stringent shall be provided.

H. Electrical Contractor shall review the Architectural drawings for work station, casework details and section drawings that show raceway details. Furnish the raceway as noted and detailed.

I. Contractor shall carefully review the Code sections pertaining to safe working clearances to avoid piping, ducts interferences and other equipment. Install the electrical equipment to meet Code requirements. Adjust the locations shown as required.

1.4 TRENCHING AND RELATED UNDERGROUND WORK

A. The Electrical Contractor shall contact "811" 72 hours prior to any excavation to locate existing underground utilities. Pay all costs to obtain the services of a specialty utility service company to locate all private utilities as required.

B. Prior to any actual trenching, Electrical Contractor shall review the utility maps; shall visually observe and review the intended routing for above and below ground obstruction; shall confer with the appointed field representative, and shall establish preliminary location for trenching.

C. After this routing is established, Contractor shall hand dig in areas of obstructions where powered equipment is non-accessible.

1.5 MATERIALS AND WORKMANSHIP

A. All materials and equipment furnished for installation on this project shall be new and in strict accordance with this specification. All packaged materials shall be delivered in the original containers which show the manufacturer's name and the

identifying designations as to size, quality, etc. Materials delivered to the job in unmarked or mutilated packages will be immediately inspected by the Contractor. Materials or equipment judged as “damaged” by the Contractor’s own inspection shall be immediately addressed with the supplier. All electrical equipment shall bear the Underwriter’s Label.

B. All work shall be performed in a professional manner under the supervision of the electrical project manager. The project manager shall be considered the main point of contact for the Architect/Owner’s daily communication.

C. Should any dispute arise as to the quality or fitness of the materials or workmanship, Architect, Owner, Engineer and Electrical Contractor shall mutually agree work is non-acceptable and shall be reworked at no additional cost to the Owner.

D. Division 26, 27 & 28 equipment schedule descriptions shall govern if it is found that the manufacturer’s catalog numbering shown on the drawing is not current, or changed by the manufacturer without notification. Division 26, 27 & 28 Contractor shall notify the Architect/Engineer with any conflicts during the bidding phase to get clarifications. After entering into a Contract, it shall be considered the equipment schedules provide the information to meet the intended specifications for quality and performance.

1.6 GUARANTEES

A. All equipment and work performed under Division 26, 27 & 28 shall be guaranteed for one (1) year from time of substantial completion of project, unless directed otherwise in Division 1.

1.7 VOLUNTARY ALTERNATES

A. The Architect/Engineer will only accept voluntary alternate as a bid deduct. Alternate must maintain the same level of quality to meet the design intent. Voluntary alternates must be submitted with the bid for review by the Owner. Failure to comply will be no reason to accept any voluntary alternates after entering into a contract.

1.8 OWNERS ACCEPTANCE OF EQUIPMENT

A. Refer to Division 1.

B. Upon the Owner’s written acceptance, the Electrical Contractor’s guarantee period shall begin and the Owner shall accept the responsibility for operation and maintenance and the Contractor’s liability shall be limited to the conditions covered in the guarantee as described in these specifications.

1.9 REFERENCES

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

1.10 SUBMITTALS

A. Submit electronic shop drawing files.

B. Proposed Products List: Include Products specified in the following Sections:

1. Section 26 05 19 - Low Voltage Electrical Power Conductors and Cables
2. Section 26 09 23 - Lighting Control Devices
3. Section 26 22 13 - Dry Type Transformers
4. Section 26 24 13 - Switchboards
5. Section 26 24 16 - Panelboards
6. Section 26 27 26 - Wiring Devices
7. Section 26 28 16 - Enclosed Switches and Circuit Breakers
8. Section 26 29 13 - Enclosed Controllers
9. Section 26 51 00 - Interior Lighting
10. Section 26 56 00 - Exterior Lighting
11. Section 26 05 26 – Grounding and Bonding for Electrical Systems
12. Section 26 05 29 – Hangers and Supports for Electrical Systems
13. Section 26 05 33.13 – Conduit for Electrical Systems
14. Section 26 05 33.16 - Boxes for Electrical Systems
15. Sections 26 05 73 – Power Systems Studies
16. Section 27 05 28 – Pathways for Communication System
17. Section 27 15 00 – Communications Horizontal Cabling
18. Section 27 51 16 – Public Address Systems
19. Section 28 46 13 - Fire Alarm System

C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in single submittals.

D. Mark dimensions and values in units to match those specified.

E. Shop drawings shall be reviewed and checked by the Electrical Contractor for specification compliance prior to release for the Engineer’s review. Failure to comply will be no cause or reason for additional costs to the Owner with project delays.

F. Electrical distribution submittal shall include cut sheets for each piece of equipment. Written description is not acceptable.

G. Bill of materials shall be submitted as part of O&M Manual. Bill of Materials is not considered a shop drawing.

1.11 REGULATORY REQUIREMENTS

A. Conform to applicable Building Code.

B. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

C. Equipment: U.L. tested and approved for its purpose.

D. The Electrical Contractor shall obtain and pay for all permits and inspection fees. Provide the Owner with final inspection documents from authorities having jurisdiction.

E. State of Michigan, Bureau of Fire Services for Emergency Lighting and Fire Alarm Plan Review.

B. Equipment: Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

F. Life Safety NFPA 101 – The State of Michigan current adopted edition.

G. Fire Alarm Code NFPA 72 – The State of Michigan current adopted edition.

H. 2021 Michigan Energy Code.

I. ASHRAE 90.1 2019 Edition.

J. 2019 School Rules.

1.12 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on drawings, unless prevented by project conditions.

B. All bidders shall personally inspect the site and acquaint themselves with all existing conditions involved in execution of this contract, and make all necessary measurements. No “extra” will be considered for additional work required because of bidder’s failure to do so.

C. Arc flash warning labels. Provide arc flash generic warning labels in accordance with 2023 NEC Section 110 requirements.

D. Provide PPE arc flash warning labels as specified with arc flash/short circuit coordination study

1.13 TEMPORARY SERVICES

A. Division 26 Trades shall provide and maintain wiring for all interior construction lighting and power to meet OSHA Standards. Division 26 Trade shall provide and maintain all required lamps and guards. Contractor’s power tools, cords, etc. shall be in strict accordance with National Electrical Code 2023, Article 590.

B. Electrical Contractor shall pay for all temporary internet and power for their office and or construction trailer.

C. Electrical Contractor shall be responsible to review Division 1 requirements to provide project temporary lighting and power requirements for the construction and demolition phases.

1.14 RECORD DRAWINGS

A. The Electrical Contractor shall furnish as-constructed drawings, including all Addendums, Bulletins and associated Field Directed Changes included as part of the record drawings.

1.15 OPERATION AND MAINTENANCE MANUALS

A. Verbal instruction and written operational instructions are to be given on all equipment and systems under this contract. A time is to be scheduled with the Architect/Engineer and Owner for these instructions and a time submitted in writing for instructions at the facility.

B. Two (2) bound sets of Operating and Maintenance Manuals are to be submitted to the Architect/Engineer for approval. Manuals are to include complete parts list and maintenance procedures as well as operating instructions on all equipment supplied under Division 26, 27 & 28.

END OF SECTION

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SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

A. Section includes basic electrical requirements, which are applicable to all Division 26 sections.

1.2 REGULATORY REQUIREMENTS

A. Conform to requirements of the applicable:
1. Michigan Building Code
2. National Fire Protection Association 70, 2023 National Electrical Code
3. 2023 State of Michigan Electrical Code Rules Part 8
4. 2017 ICC/ANSI A117.1
5. Local Codes
6. National Fire Protection Association 101, Life Safety Code
7. National Fire Protection Association 72, Fire Alarm Code
8. Other applicable National Fire Protection Association Codes
9. State of Michigan Uniform Energy Code.

1.3 WORKMANSHIP

A. Should any dispute arise as to the quality or fitness of the materials or workmanship, Engineer, Owner and Electrical Contractor shall mutually agree Work is non-acceptable and collaborate on an agreeable solution.

B. All Division 26 Work shall be done under the direction of a currently licensed State of Michigan Master Electrician. All Work shall be provided in a professional manner.

PART 2 PRODUCTS

2.1 GENERAL PRODUCTS

A. All Products, shall be listed by and shall bear the label of an approved Nationally Recognized Testing Laboratory (NRTL) as identified by the United States Occupations Safety and Health Administration (OSHA), per the OSHA Nationally recognized Testing Laboratory Program. If none of the approved electrical testing laboratories has published standards for a particular item, then other national independent testing standards, if available, applicable, and approved by the owner, shall apply and such items hall bear those labels here one of the approved electrical testing laboratories has an applicable system listing and label, the entire system, shall be so labeled.

B. Where Products are used which defer in arrangement, configuration, dimensions, ratings, or engineering parameters from these indicated on the contract

documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space, and for obtaining the performance from the system into which these items are placed.

C. Manufacturer references used herein are intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply.

D. All Products provided for installation on this project shall be new and in strict accordance with this specification. All packaged material shall be delivered in the original containers which show the manufacture's name and the identifying designations as to size, quality, etc. Material delivered to the Project in unmarked or mutilated packages will be ordered to be removed from the site at once. Materials or equipment judged as "damaged" by the Owner or Engineer shall be removed from the Project. All electrical equipment shall bear the Underwriters Label.

E. All materials, shall be listed by and shall bear the label of an approved Nationally Recognized Testing Laboratory (NRTL) as identified by the United States Occupations Safety and Health Administration (OSHA), per the OSHA Nationally recognized Testing Laboratory Program. If none of the approved electrical testing laboratories has published standards for a particular item, then other national independent testing standards, if available, applicable, and approved by the owner, shall apply and such items hall bear those labels here one of the approved electrical testing laboratories has an applicable system listing and label, the entire system, shall be so labeled.

F. Divisions 26 Product schedule descriptions shall govern if it is found that the manufacture's catalog numbers as shown on the Drawings are not current or changed by the manufacturer without notification. Divisions 26 contractor shall notify the Engineer with any conflicts during the bidding phase to get clarifications. After entering into a Contract, it shall be considered the equipment schedules provide the information to meet the intended specification for quality and performance.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine the site and all the Drawings before proceeding with the layout and installation of this Work. Verify all door swings and clearances to cabinets, etc., before locating devices, boxes support Etc. Locate conduit, boxes, etc., essentially as shown on the drawings but in exact layout determined on the job to suit actual conditions. Confer and cooperate with the Owner and other trades performing Work on site so all parts will be installed in proper relationship. Precise locations of parts to coordinate with other Work is the responsibility of the Contractor.

3.2 TEMPORARY SERVICES

A. Division 26 trades shall provide and maintain wiring for all interior construction lighting and power to meet OSHA standards. Division 26 Trade shall provide and maintain all required lamps and guards. Contractor's power tools, cords, etc. shall be in strict accordance with e National Electric Code 2023 Article 590.

3.3 POWER OUTAGES

A. No power outages shall be permitted on existing systems except at the time and interval specified by the Owner/Engineer. The Owner may require written approval, any outage must be scheduled when the interruption causes the least interference with normal schedules and business routines. NO extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours.

B. The Contractor shall provide a detailed outage plan and conduct outage planning meetings with the Owner/Engineer in preparation for the outage.

C. The Contractor shall restore any circuit interrupted as a result of this work to proper operation as soon as possible.

3.3 RECORD DRAWINGS

A. The Electrical Contractor shall furnish as-constructed drawings, including all Addendums, Bulletins and associated Field Directed changes included as part of the record drawings.

END OF SECTION

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SECTION 26 05 05

SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical demolition per plans and specifications.

B. Conduit supports.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Electrical Contractor shall examine the project documents and visit the site as they deem necessary prior to submitting a bid. Do not rely solely on the Electrical Plans for all demolition requirements. Review all Project Documents prior to submitting a bid.

B. The demolition information is provided to assist with labor costs associated with the electrical systems removal. The Electrical Contractor shall be responsible to confirm all quantities and the information provided.

C. Upon removal of the existing ceiling, the Electrical Trades shall immediately notify the construction manager, Architect and Engineer in writing regarding existing conduits scheduled to remain that are not properly supported. Conduit evaluation shall be conducted with the Owner, Architect and Engineer. Failure for the Electrical Trades to submit a written conduit support condition will obligate the trade to support the conduits to meet current Code methods at no additional cost to the Owner.

3.2 PREPARATION

A. Confirm with the Architect's Office and/or Construction Manager Project Schedules and review the Architectural, Structural and Mechanical drawings prior to commencing demolition.

3.3 DEMOLITION

A. As noted or shown on the demolition plans, remove the electrical distribution equipment, lighting, receptacles, switching, associated conduit, surface raceway. Remove the fire alarm system as noted or shown or shown on the drawings. Remove surface mounted conduit, boxes, and non-metallic raceway, from the existing walls in offices, classrooms, etc. Use care during the demolition phase to avoid damage or any glazed block, tile or brick veneered walls. Electrical Contractors are responsible to confirm all quantities and information provided.

B. Mechanical trades or BAS Contractor shall remove all associated temperature components, and associated conduit and wiring.

C. Electrical Trades shall remove all existing fire alarm devices and associated conduits and surface mounted raceways. Patch to match.

D. Electrical Trades shall transport all of the electrical salvaged materials to the Owner and include all transportation costs.

E. Electrical Trades shall remove all of the existing electrical branch panelboards as noted, scheduled and shown on the drawings and specifications. Confirm all outages with the Owner to starting the replacement work.

F. As noted or shown on the demolition plans, remove all of the existing non-metallic type surface raceway or surface metal conduits noted or specified to be removed. Contractor shall also be responsible to review the architectural, structural and mechanical demolition drawings for associated electrical demolition work. Do not rely solely on the electrical drawings for bid submitted.

G. Remove all unused conduits and wiring serving lighting and power being removed from the finished ceiling space. Remove all abandoned low voltage cables from accessible portions in accordance with NEC Sections 760.25(A), 640(A), 645.3(A), 725.3(B), 770.3(A), 800.3(C), 820.3(A) and 830.3(A). Include costs in bid to walk the ceiling spaces with the Construction Manager and the Owner for visual assessment of abandoned cables.

H. As noted or shown on the demolition drawings, remove the exterior light fixtures. Backbox in-fill shall be completed as part of the masonry upgrade unless noted otherwise. Reuse the existing fixture backbox as noted on the drawings. Remove flood light fixtures that are mounted on a pipe mast, supported on the roof. It shall be the roofing contractor's scope of work to repair the roof upon the support removal.

I. Electrical Contractors are responsible to confirm all demolition quantities. Make pre-bid site visit arrangements as deemed necessary.

J. All security system removal and reinstallation shall be completed by the Owner unless otherwise noted.

END OF SECTION

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SECTION 26 05 19

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Building wire and cable.

B. MC cable

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

1.4 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Conductor sizes are based on copper.

C. Routing shown on Drawings is approximate unless dimensioned. Field route as required to best suit Project Conditions.

D. Where wire and cable routing is not shown, and only a load destination is shown, determine exact routing and lengths required.

1.5 COORDINATION

A. Coordinate Work under provisions of Division 1.

B. Determine required separation between cable and other work.

C. Determine cable routing to avoid interference with other work.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 BUILDING WIRE AND CABLE

A. Description: Single conductor insulated wire.

B. Conductor: Copper.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: ANSI/NFPA 70, Type THW, THHN/THWN, XHHW-2.

2.2 MC CABLE

A. Factory assembled multiple insulated conductors enclosed in armor of interlocking metal corrugated sheath.

B. Provide all clips and supports.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Use stranded conductors for control circuits.

C. Use conductor size not smaller than 12 AWG for power and lighting circuits.

D. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 100 feet.

E. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.

F. Pull all conductors into raceway at same time.

G. Protect exposed cable from damage.

H. Support cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.

I. Use suitable cable fittings and connectors.

J. Neatly train and lace wiring inside boxes, equipment, and panelboards.

K. Clean conductor surfaces before installing lugs and connectors.

L. Splices are not permitted.

M. All power wiring shall be installed in conduit. Low-voltage wiring (<60V) shall utilize the channel trays-hooks or free-air method, or other cable management methods that meet industry standards as noted on the drawings. Conduit drops for fire alarm devices, card readers, power assisted doors, and voice/data outlets shall be required. Electrical Trades shall be responsible for coordinating with the Owner's low-voltage (<60V) system and drawings for required raceway. Low voltage (<60V) cables installed in accessible ceiling space need not to be in conduit. However, the cables must be properly secured to the ceiling structure.

N. Refer to Section 26 09 23 for Occupancy Sensors wiring.

O. Refer to Section 27 00 00 for Network/Communication wiring.

P. Refer to Section 27 51 16 for Public Address System wiring.

Q. Refer to Section 28 31 00 for Fire Alarm wiring.

R. If the Electrical Trades Contractor elects, at their option, to combine homerun circuits installed in a single conduit, the derating 2023 NEC 310.15(b) Table must be utilized for allowable conductor ampacity values. If the derating method is utilized, then furnish and install properly derated cables and properly sized conduits to meet Code. Electrical Trades Contractor shall be responsible to obtain inspection from the Electrical Inspector and pay all supplemental inspection and/or requested plan review fees.

S. Shared neutrals for lighting and power circuits are not permitted.

T. MC cable shall only be acceptable as the final connection to light fixtures installed in accessible ceilings. Maximum cable shall not exceed 6 feet. MC cable shall not be used for homeruns or feeders.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Section 26 05 53.

B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.4 FIELD QUALITY CONTROL

A. Perform field inspection and testing to assure proper operation.

B. Inspect wire and cable for physical damage and proper connection.

C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

D. Verify continuity of each branch circuit conductor.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grounding electrodes and conductors.

B. Equipment grounding conductors.

C. Bonding.

D. Building foundation grounding.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

1.4 PERFORMANCE REQUIREMENTS

A. Resistance: Meet the NEC Code requirements.

1.5 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of grounding electrodes.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 ROD ELECTRODE

A. Material: Copper-clad steel or copper-weld type.

B. Diameter: as scheduled on the drawings.

C. Length: as scheduled on the drawings.

2.2 MECHANICAL CONNECTORS

A. As scheduled on the drawings.

2.3 EXOTHERMIC CONNECTIONS

A. As scheduled on the drawings.

2.4 WIRE

A. Material: As scheduled on the drawings.

B. Foundation Electrodes: Size to meet NFPA 70 requirements.

C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site soil conditions before driving rod electrodes.

3.2 INSTALLATION

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

B. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

C. Provide bonding to meet Regulatory Requirements.

D. Provide supplemental and service entrance grounding in accordance with 2023 NEC Section 250. Refer to Table 250-66

E. Equipment Grounding Conductor: Provide a separate grounding conductor for lighting and power circuits as noted or specified on the drawings.

F. Bond the paralleled service entrance conduits in accordance with NEC 2023 Section 310.10 requirements.

G. In the case of an isolation ground system, the metal raceway may be used as the equipment ground and an insulated grounding conductor as the isolated ground. If PVC conduit is utilized, then two insulated grounding conductors shall be installed.

H. Complete the grounding conductor to the building foundation rebar in accordance with 2023 NEC 250-52 (3) requirements.

I. As shown and noted on the drawings, provide ground conductor from the new addition's foundation rebar back to the building's main distribution panel service ground bar. Provide minimum #6 grounding conductor from the main electric distribution equipment to the data racks.

3.3 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

END OF SECTION

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SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Conduit and equipment supports.

B. Anchors and fasteners.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Materials and Finishes: Provide adequate corrosion resistance.

B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

C. Anchors and Fasteners:
1. Concrete Structural Elements: Use expansion anchors.
2. Steel Structural Elements: Use beam clamps.
3. Concrete Surfaces: Use self-drilling anchors and expansion anchors.

4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
5. Solid Masonry Walls: Use expansion anchors.
6. Sheet Metal: Use sheet metal screws.
7. Wood Elements: Use wood screws.

PART 3 EXECUTION

3.1 INSTALLATION

A. Attachments of electrical equipment to structural members are the responsibility of the installing trade. Structural members shall not be field cut, welded or otherwise modified without approval of the Architect/Engineer. Attachment to steel joist shall be made at panel points whenever possible. Structural members shall not be overloaded as a result of attachments. Attachment/equipment loading for all trades resulting in total load greater than an equivalent uniform 5 psf for any member shall be submitted to the Architect/Engineer for review. Electrical Trades are still responsible for design, layout, and fabrication and installation of electrical supports and support attachment methods. Electrical Trades shall submit attachment methods to the Structural Engineer for review.

B. Install products in accordance with manufacturer's instructions.

C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

D. Do not use spring steel clips and clamps.

E. Do not use powder-actuated anchors.

F. Do not drill or cut structural members without permission from Architect/Engineer.

G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

H. Install surface-mounted cabinets and panelboards with minimum of four anchors.

I. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

J. No drilling of laminated wood beams without structural engineer review.

END OF SECTION

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SECTION 26 05 33.13

CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal conduit.

B. Flexible metal conduit.

C. Liquidtight flexible non-metallic conduit.

D. Electrical metallic tubing.

E. Nonmetal conduit.

F. Electrical nonmetallic tubing.

G. Flexible nonmetallic conduit.

H. Fittings and conduit bodies.

I. Surface raceway assembly.

J. MC Cable.

K. Flexible metal conduit.

L. HDPE conduit.

M. Conduit water sealant.

N. Conduit seals (foundation walls).

1.2 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

1.3 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned,

listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.4 REFERENCES

A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.

B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.

C. ANSI C80.3 - Rigid Aluminum Conduit.

D. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

E. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

F. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

G. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).

H. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.5 DESIGN REQUIREMENTS

A. Conduit Size: ANSI/NFPA 70.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle Products to site.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

1.8 PROJECT CONDITIONS

A. Verify routing and termination locations of conduit prior to rough-in.

B. Conduit routing shown is diagrammatic, field route conduit to avoid interferences.

1.9 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 CONDUIT REQUIREMENTS

A. Minimum Size: ¾ inch unless otherwise specified.

B. Underground Installations:

1. Use Schedule 40 PVC conduit for general underground installation.
2. Use Schedule 80 PVC conduit for heavy traffic areas.
3. Use direct burial seamless HDPE as noted and shown on the drawings for underground installation.

C. Outdoor Locations, Above Grade: Use rigid steel conduit.

D. Wet and Damp Locations: Use rigid conduit or liquid-tight non-metallic flexible conduit.

E. Dry Locations:
1. Concealed: Use electrical metallic tubing.
2. Exposed: Use electrical metallic tubing.
3. Use minimum ¾” conduit for TV outlet and fire alarm drops.
4. Use flexible metal conduit for final wiring connections to motors, VFD units, light fixtures in accessible ceiling and interior transformers.
5. Use minimum 1” conduit for voice/data wiring.
6. Use minimum 1¼” conduit for ceiling projectors.

2.2 METAL CONDUIT

A. Rigid Steel Conduit: ANSI C80.1.

B. Fittings and Conduit Bodies: ANSI C80.5.

C. Intermediate Metal Conduit (IMC): Rigid Steel.

D. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit.

2.3 FLEXIBLE METAL CONDUIT

A. Description: Interlocked steel construction.

B. Fittings: ANSI/NEMA FB 1.

2.4 LIQUID-TIGHT NON-METALLIC FLEXIBLE METAL CONDUIT

A. Description: Type NM. Manufacturer with a spiral of rigid PVC embedded reinforcement with a flexible PVC wall.

B. Compatible fittings.

C. Use for wet or exterior location as final wiring connections to motors or electrical equipment, etc.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Description: ANSI C80.3; galvanized tubing.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; set screw type.

2.6 NONMETALLIC CONDUIT

C. Description: NEMA TC 2; Schedule 40 PVC.

D. Fittings and Conduit Bodies: NEMA TC 3.

2.7 SURFACE RACEWAY ASSEMBLY

A. One steel raceway as scheduled or noted on the drawings.

B. Divided non-metallic raceway basic components
1. Base cover
2. Flat elbow
3. Divided entrance fitting
4. Blank end fitting
5. Dividers
6. Fill-in covers
7. 2 gang horizontal device bracket

2.8 FIRE RATED WIREWAY

A. As scheduled on the drawings.

B. Wireway sizes and quantities shall be based on the cable counts as determined by the Contractor.

2.9 MC CABLE

A. Corrugated steel tubing with integral conductors.

B. Use MC cable as noted on the drawings and specified in Low Voltage Electrical Power Conductors & Cables Specification 26 05 19.

C. MC cable is not permitted for homeruns or feeders or branch device drops.

2.10 HDPE CONDUIT

A. Smooth seamless for direct burial application.

B. PVC cement is not acceptable for HDPE to PVC connection. Acceptable conduit adhesive shall be “Bonduit” offered by Polywater or approved equal.

C. Use HDPE conduit couplers for transition to interduct, PVC or threaded steel conduit. Provide “E-loc” or electrofusion coupler type manufactured by Lamson Pipe Company or approved equal by Shur-Lock couplers by Arnco Corporation.

D. Refer to NEC 2023 Section 353 for the HDPE conduit connection and installation methods.

E. HDPE conduit is not acceptable for exposed installations.

2.11 WATER SEALANT

A. Use “Polywater FST” for a means and methods to seal leaking conduits. Follow the manufacturer’s instructions.

2.12 CONDUIT SEALS (FOUNDATION WALLS)

A. Modular elastomer type. EDM seal element. Nylon reinforcement. Pressure plate zinc plated bolts and nuts. Follow manufacturer’s sizing chart and installation manual. Eaton Link Seal or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install nonmetallic conduit in accordance with manufacturer’s instructions.

B. Arrange supports to prevent misalignment during wiring installation.

C. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

D. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.

E. Fasten conduit supports to building structure and surfaces under provisions of Section 26 05 29.

F. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

G. Do not attach conduit to ceiling support wires.

H. Arrange conduit to maintain headroom and present neat appearance.

I. Route conduit parallel and perpendicular to walls or building centerlines.

J. Route conduit installed above accessible ceilings parallel and perpendicular to walls. Install metal conduit sleeves or fire rated assembly in all fire rated wall as identified on the electrical or architectural life safety plans.

K. Route conduit in and under slab from point-to-point.

L. Do not cross conduits in slab.

M. Maintain adequate clearance between conduit and piping.

N. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

O. Cut conduit square using saw or pipecutter; de-burr cut ends.

P. Bring conduit to shoulder of fittings; fasten securely.

Q. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

R. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

S. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams.

T. Provide suitable fittings to accommodate expansion and deflection where conduit crosses, control and expansion joints. Use a UL listed expansion joint. If expansion length exceeds the manufactured expansion fitting, the use of PVC coated metallic flexible conduit is an acceptable method.

U. Provide suitable pull wire in each empty conduit except sleeves and nipples.

V. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

W. Ground and bond conduit under provisions of Section 26 05 26.

X. Identify conduit under provisions of Section 26 05 53.

Y. Firestop the conduits passing thru fire rated walls. Electrical Contractor shall be responsible to review the Architectural Life Safety drawings for fire rated wall locations.

Z. The control system contractor shall be responsible to adhere to the mechanical plans and/or temperature control system drawings to establish conduit routes.

AA. Electrical Contractor shall be required to install new conduit (concealed) in all finished areas for the following, but not limited to: exit lights, clocks, light fixtures, receptacles, sensors, switching, fire alarm manual pull stations, horn/strobe unit and strobe units, etc. Saw cut, channel and patch the walls. Neatly saw cut all existing brick veneer, glazed block or tiled areas to complete the new work. Firestop all conduits passing through fire rated walls, floors or separation barriers. Take the necessary steps to prevent chipping during the saw cutting and or wall channeling operation in the brick veneer, glazed tile or block areas. It shall be acceptable to install conduit from the opposite wall side to minimize brick veneer, glaze block or tile work. In non-finished spaces such as janitor closets, mechanical rooms, hub rooms, electrical rooms and storage rooms, conduit can be surface mounted. Provide flush mounted device boxes in all new wall construction as shown on the architectural drawings. Conduit drops or MC cable shall be concealed in the new walls and as noted and specified on the drawings.

BB. All power, voice, clock, public address, data, fire alarm, occupancy sensor lighting wiring installed in exposed spaces shall be installed in conduit.

CC. Electrical Contractor shall install the non-metallic divided surface raceway as noted or shown on the drawings. Refer to Electrical plans for a typical raceway detail.

DD. Low-voltage voice and data device conduit drops shall only be required to be extended into the accessible ceiling space or to a cable tray as noted or specified on the drawings.

EE. Contractor shall provide separate raceway for the emergency power distribution system.

FF. Electrical Contractor shall identify emergency power. Identify all of the junction box cover plates with panelboard source ID and circuit number(s). Provide engraved label. Handwritten on the junction box cover plate is not acceptable.

GG. Provide conduit wall sleeves for low-voltage wiring installation as shown and noted on the drawings. Firestop the conduit openings. Use fire rated wireway as specified or noted on the drawings.

HH. Multiple non-metallic conduit duct bank shall include top, intermediate and bottom PVC conduit spacers spaced on 60” centers.

II. Provide empty conduit for power assisted doors as noted and shown on the drawings.

JJ. Provide empty conduit for security system as noted and shown on the drawings.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods consistent with facility standards or this project specification. Contractor is responsible to review the Architectural drawings to determine fire rated locations.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket or detail to match roof type specified.

C. No drilling of the existing gym laminated beams is permitted without a review with the project Structural Engineer.

END OF SECTION

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SECTION 26 05 33.16

BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall and ceiling outlet boxes.

B. Floor boxes.

C. Pull and junction boxes.

D. Fire alarm device boxes.

E. Public address speaker backbox assembly.

F. Clock boxes.

G. TV outlet.

H. Voice/data boxes.

I. Occupancy sensor boxes.

J. Power assisted door boxes.

K. Security system boxes.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.

B. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

1.4 SUBMITTALS FOR REVIEW

A. Provide submittal as listed in Section 26 01 00.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 BRANCH DEVICE BOXES

A. Sheet Metal Outlet Boxes: Use 4” square stamped steel box with single gang device ring as general project requirement.

B. Nonmetallic Outlet Boxes: NEMA OS 2. (Not permitted unless as noted on the drawing).

C. Cast Aluminum Boxes: for exterior location us a single gang shallow box with thread hub connection. Provide gasketed cover by box manufacturer.

D. Use masonry box in masonry walls.

E. Use 4” octagon box for ceiling smoke detectors.

F. Use in line non-metallic type box in non-metal surface raceway assembly as scheduled and detailed on the drawings.

G. Elevator service pit box for the receptacle shall be NEMA 4 to meet State Elevator Code.

2.2 FLOOR BOXES

A. As scheduled on the drawing.

2.3 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes
1. NEMA 1 enclosure for interior location.
2. NEMA 3R or 4X for exterior location.
3. Stainless steel for food service area.
4. Non-metallic pull and junction boxes are not permitted for this project unless noted otherwise.

2.4 OCCUPANCY SENSORS

A. Refer to the manufacturer for box requirements.

2.5 PUBLIC ADDRESS AND TELEVISION DISTRIBUTION SYSTEM

A. Refer to Sections 26 06 50 and 27 13 33.

2.6 VOICE AND DATA BOXES

A. Use 4 11/16” square stamped steel box with a single gang device.

2.7 POWER ASSISTED DOOR BOXES

A. Provide 4” square box for palm button backbox for use by the installing vendor.

2.8 SECURITY BOXES

A. Provide empty 4” square boxes as noted and shown on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in locations as shown on Drawings, and as required for wire pulling, equipment connections and compliance with regulatory requirements.

B. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.

D. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.

E. Maintain headroom and present neat mechanical appearance.

F. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

G. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

H. Install boxes to preserve fire resistance rating of partitions and other elements.

I. Coordinate mounting heights and locations of outlets for counters, backsplashes, benches in casework and workstations.

J. Locate outlet boxes to allow luminaires positioned as shown.

K. Align adjacent wall mounted outlet boxes for switches, etc.

L. Use flush mounting outlet box in finished areas. Surface mounted boxes are acceptable for non-finished spaces.

M. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

N. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in acoustic rated walls.

O. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

P. Use stamped steel bridges to fasten flush mounting outlet box between studs.

Q. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

R. Use adjustable steel channel fasteners for hung ceiling outlet box.

S. Do not fasten boxes to ceiling support wires.

T. Support boxes independently of conduit.

U. Use gang box where more than one device is mounted together. Do not use sectional box.

V. Use gang box with plaster ring for single device outlets.

W. Install floor boxes flush with the finished floor.

X. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations. Set floor boxes level.

Y. Install in line boxes in the surface mounted raceway system as shown on the drawing.

Z. Large Pull Boxes: Provide screwed cover or hinged enclosure in interior dry locations as noted or specified on the drawing.

AA. Junction box cover plates installed above the ceiling shall be facing down.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Coordinate installation of outlet box for equipment connected under other sections.

B. Refer to Section 28 31 00 for fire alarm mounting height.

C. Install public address speaker backbox at locations noted or shown on the drawings. Confirm final ceiling location to avoid the interferences with light fixtures, fire alarm and HVAC diffusers.

3.3 ADJUSTING

A. Adjust floor box flush with finish flooring material.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused box openings.

END OF SECTION

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SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates and labels.

B. Wire and cable markers.

C. Labeling methods and standards.

D. Conductor color coding and identification.

E. Panelboard directory.

F. Underground warning tape.

G. Arc flash warning labels.

H. Voice/data faceplates and data rack patch panel ports.

I. Electrical distribution equipment.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 NAMEPLATES AND LABELS

A. Nameplates:
1. Engraved three-layer laminated plastic, black letters on white background for normal power.

B. Locations:
1. Each electrical distribution panelboard, switchboard and power panel.
2. Each starter.
3. Each disconnect.
4. Automatic transfer switches.
5. Emergency circuit junction box cover plates.
6. MDF/IDF patch panel ports.
7. Voice/data outlets.
8. Each VFD.
9. Boiler e-stop station.

C. Nameplate size minimum 1”x3” or match existing.

2.2 WIRE MARKERS

A. Manufacturers:
1. Brady or equal.

B. Description: Tape type wire markers.

C. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.

D. Legend:
1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
2. Control Circuits: Control wire numbers.

2.3 LABELING METHODS AND STANDARDS

A. Engraved Labels
1. All electrical panels, starters, disconnect switches, terminal cabinets, fire alarm panel, or similar central system cabinet shall be permanently identified using engraved labels. These labels shall be secured with double face type or mechanically fastened in applications where the tape may have a tendency to fail.
2. Normal power fed systems shall have white labels with black lettering.
3. Lettering sizes may vary due to space constraints or to distinguish between main versus branch systems. Sizes should be consistent throughout the project, use the following guidelines:

Switchboard or Panelboard Main Label: 1” high minimum

Switchboard or Panelboard Branches	1/2" high minimum
Starters, Disconnects, VFDs, Boiler e-stop station	1/2" high minimum
Manual Motor Starters	1/4" high minimum

4. All labels shall identify where panel or equipment is fed from and the circuit number. Ex (panel A fed from MDP)

B. Adhesive Tape Labels
1. Receptacles shall have the circuit number identified on the device cover plate using clear adhesive tape labels with 1/4" high printed block characters in black.
2. Provide circuit identification on junction or pull box covers for all circuits within.
3. Conductors in branch circuit panelboards shall have phase conductors, neutrals and grounds identified with adhesive labels within the panel at junction or pull boxes and at the device outlet box. Refer also to conductor color coding with respect to operating voltage.

2.4 CONDUCTOR COLOR CODING AND IDENTIFICATION

A. Feeder phase conductors shall be identified as to phase and operating voltage using colored tape as follows:

	480 Volt	120/208 Volt
Phase A	yellow	black
Phase B	brown	red
Phase C	orange	blue
Neutral	gray	white
Ground	green	green

B. Conductors from #18 up through #10 shall have colored insulating jackets to match the color code and phasing scheme as described above for feeders. Receptacle and lighting circuit conductors shall be #12 minimum for 15 or 20 amp circuits. Conductors #18 through #14 shall only be used for control circuits with colored jackets and wire numbers correlated to each system accordingly.

C. Spare conductors shall be clearly identified as such through color, labels, tags, etc.

2.5 PANELBOARD DIRECTORY

A. Provide typed directory. Handwritten is not acceptable.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

A. Install nameplate and label parallel to equipment lines.

B. Secure nameplate to inside surface of door on panelboard.

C. Contractor shall review the drawings to confirm all label schemes or ID requirements listed or noted on the drawings. Review mechanical drawings for equipment ID designation to provide a ID tag that corresponds to the mechanical equipment.

D. Provide arc flash generic warning label on all electrical distribution equipment in accordance with NEC 2023 requirements. Provide PPE arc flash warning labels as specified with arc flash/short circuit coordination study.

E. Panelboard, switchboards, transformers, etc. shall include their source of power included in nameplate label. (i.e. LPA feed from PP2)

END OF SECTION

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SECTION 26 05 83

WIRING CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mechanical equipment.

B. Powerized modular furniture.

C. Occupancy sensor equipment.

D. Boiler disconnect.

E. Owner furnish equipment.

F. Electrical water cooler

G. Boiler e-station

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. NEMA WD 1 - General Purpose Wiring Devices.

B. NEMA WD 6 - Wiring Device Configurations.

C. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

1.4 COORDINATION

A. Coordinate work under provisions of Division 1.

B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.

C. Determine connection locations and requirements.

D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

E. Sequence electrical connections to coordinate with start-up schedule for equipment.

F. Mechanical Trades shall be responsible to furnish and install all temperature control components, associated conduit, wiring and 120 volt power supplies. Electrical Trades shall reserve 120 volt circuit breaker as scheduled in the panels for this purpose.

G. All VFD programming shall be completed as part of the Mechanical Trades work.

H. Provide a readily accessible GFI outlet for electrical water cooler.

I. Boiler emergency stop station shall disconnect main power to the boiler(s).

J. Where equipment will cover a GFI outlet within 6 feet of sink, provide a blank feed thru GFI test station.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 CORDS AND CAPS

A. Manufacturers:
1. Hubbell, Pass & Seymour, Leviton or equal.

B. Attachment Plug Construction: Conform to NEMA WD 1.

C. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

D. Cord Construction: ANSI/NFPA 70, Type SO multi-conductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit over current protection.

2.2 BOILER DISCONNECT SWITCH

A. Lockable type to meet ASME-1 2023 Standard.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify conditions under provisions of Division 1.

B. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using metallic flexible conduit for all dry interior locations. Use liquid tight non-metallic flexible conduit with watertight connectors in damp or wet locations and kitchen areas.

C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

D. Provide the NEMA configuration that matches receptacle.

E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

F. Install disconnect switches, power relays, motor starters and as noted on the drawings.

G. Provide and install fuses in mechanical trades furnished fused disconnects and combination starters per manufacturer’s requirements.

H. Final power connection to powerized furniture shall be completed by the installing vendor. Where the furniture system utilizes shared neutrals, the Electrical Trades shall furnish and install a circuit breaker tie.

I. Electrical Contractor shall install mechanical furnished motor speed control and as required to control motor speed.

J. Complete all lighting controls as scheduled, noted and shown on the drawings.

K. Electrical Contractor shall complete all main power wiring to the mechanical equipment shown and noted.

L. VFD control wiring and programming shall be completed as part of the Mechanical Trades bid. VFD shall be factory installed with the equipment unless noted or specified otherwise.

3.3 BOILER LOCKABLE DISCONNECT INSTALLATION

A. Lockable disconnect shall be installed within 5 feet of any side of the boiler it is serving. Lockable disconnect location shall not interfere with the boiler service clearances.

3.4 BOILER E-STOP

A. Install at the boiler room main entry door.

3.5 BLANK FEED THRU GFI

A. Install a remote blank feed thru GFI where a refrigerator, freezer or other equipment that blocks access to the receptacle located within 6 feet of a sink.

END OF SECTION

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SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Power packs.

B. Occupancy sensor.

C. Relay panels.

D. Low voltage push button stations.

E. CAT 6 wiring.

F. Room controllers.

G. Low-voltage momentary switching.

H. Fire alarm interface.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. ASHRAE 90.1 2019 Energy Code.

B. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

C. 2021 Michigan Energy Code.

1.4 SUBMITTALS

A. Provide submittal as listed in Section 26 01 00.

B. Shop Drawings: Occupancy sensor cut sheets, control panel layouts, wiring connections, diagrams, and dimensions. Cut sheets shall either be marked or

arrowed components with catalog numbers. Failure to comply will be cause to return the submittals for corrections at no delays or extra costs to the Owner.

1.5 REGULATORY REQUIREMENTS

A. ASHRAE 90.1 2019.

B. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

C. Products: Furnish products listed or labeled to conform to requirements of 2023 National Electric Code, 2023 State of Michigan Electric Code Rules Part 8, and local authority having jurisdiction.

D. 2019 Michigan Energy Code.

E. 2021 Life Safety Code. NFPA 101. Chapter 7 – 7.8.1.2.2 Means of Egress Lighting.

PART 2 PRODUCTS – Acceptable manufacturer's – as scheduled on the drawings.

2.1 OCCUPANCY SENSORS

A. As scheduled on the drawings.

2.2 POWER PACKS

A. As scheduled on the drawings.

2.3 CEILING MOUNTED OCCUPANCY SENSORS

A. As scheduled on the drawings.

2.4 WALL SWITCH TYPE OCCUPANCY SENSORS

A. As scheduled on the drawings.

2.5 RELAY PANEL

A. As scheduled on the drawings.

2.6 CAT 6 WIRING

A. Green jacketed cable color.

2.7 DIGITAL BRIDGE CONTROLLER

A. As scheduled on the drawings.

2.8 DIGITAL ROOM CONTROLLERS

A. As scheduled on the drawings.

2.9 LOW VOLTAGE DIGITAL CONTROL STATION

A. As scheduled on the drawings.

2.10 LOW-VOLTAGE MOMENTARY SWITCHING

A. As specified or scheduled.

2.11 ADDRESSABLE RELAY FOR FIRE ALARM INTERFACE

A. As scheduled on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions and wiring diagrams.

B. Contractor shall provide all components, etc. above those specified or shown for a complete installation.

3.2 SYSTEM TRAINING

A. Include (2) 4 hours of training with the bid, four-hour training sessions. These training sessions shall be on different days, which will require two separate trips by the instructor. The training shall take place at the Owner's facility.

3.3 FUNCTIONAL TESTING

A. Provide functional testing with 2019 ASHRAE.

B. Provide certified documents that lighting controls were tested for programming and working conditions.

END OF SECTION

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SECTION 26 22 00

LOW VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Dry type two winding transformers.

B. Dry type isolation transformers.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. NEMA ST 1 - Specialty Transformers

B. NEMA ST 20 - Dry Type Transformers for General Applications.

C. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

1.4 SUBMITTALS

A. Provide submittal as listed in Section 26 01 00.

B. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

C. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

E. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

C. Department of Energy 2016 ruling 10 CFR Part 431 for transformer efficient levels.

D. Transformer shall be UL listed or labeled to meet the requirements of 2023 National Electric Code, 2023 Michigan Electric Code Rules Part 8, and local authority having jurisdiction

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store, protect, and handle products to site.

B. Deliver transformers individually wrapped for protection and mounted on shipping skids.

C. Accept transformers on site. Inspect for damage.

D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

A. Manufacturers:
1. As scheduled on the drawings.

B. Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, ratings as indicated.

C. Insulation system and average winding temperature rise for rated kVA as follows:
1. 1-15 kVA: Class 185 with 115 degrees C rise, and aluminum windings, DOE compliant.
2. 16-500 kVA: Class 220 with 115 degrees C rise, and aluminum windings, DOE compliant.

D. Case temperature: Do not exceed 40 degrees C rise above ambient at warmest point.

E. Winding Taps:
1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
2. Transformers 15 kVA and Larger: NEMA ST 20.

F. Sound Levels: NEMA ST 20. Maximum sound levels are as follows:
   1. 1-5 kVA: 40 dB.
   2. 6-25 kVA: 45 dB.
   3. 26-150 kVA: 50 dB.
   4. 151-225 kVA: 55 dB.
   5. 226-300 kVA: 55 dB.
   6. 301-500 kVA: 60 dB.

G. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

H. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

I. Mounting: Suitable for wall, floor, or trapeze mounting.

J. Coil Conductors: Continuous windings with terminations brazed or welded.

K. Isolate core and coil from enclosure using vibration-absorbing mounts.

L. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.2 ISOLATION TRANSFORMERS

A. Manufacturers:
   1. Square D or equal.

B. Description: NEMA ST 20, factory-assembled, air cooled dry type shielded isolation transformers, ratings as indicated.

C. Insulation system and average winding temperature rise for rated kVA as follows:
   1. 10-15 kVA: Class 185 with 115 degrees C rise and aluminum windings, EE type TPI rated.
   2. 16-500 kVA: Class 220 with 150 degrees C rise and aluminum windings, EE type TPI rated.
   3. Case temperature: Do not exceed 50 degrees C rise above ambient at warmest point.

D. Winding Taps:
   1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
   2. Transformers 15 kVA and Larger: NEMA ST 20.

E. Sound Levels: NEMA ST 20. Maximum sound levels are as follows:
   1. 1-5 kVA: 40 dB.
   2. 6-25 kVA: 45 dB.
   3. 26-150 kVA: 50 dB.
   4. 151-225 kVA: 55 dB.
   5. 226-300 kVA: 55 dB.
   6. 301-500 kVA: 60 dB.

F. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

G. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

H. Coil Conductors: Continuous windings with terminations brazed or welded.

I. Enclosure: NEMA ST 20, Type 1 ventilated. Provide lifting eyes or brackets.

J. Isolate core and coil from enclosure using vibration-absorbing mounts.

K. Nameplate: Include transformer connection data.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are suitable for installing transformer supports.

3.2 INSTALLATION

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

B. Set transformer plumb and level.

C. Use flexible conduit, under the provisions of Section 26 05 33.13, for the final wiring connection to the transformer. Make conduit connections to side panel of enclosure.

D. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure as noted or shown.

E. Provide grounding and bonding in accordance with Section 26 05 26.

F. Use a trapeze type transformer support or knee brace support unless noted otherwise. Refer to structural drawings for installation instructions to new roof curb.

G. New transformers shall be Nema 3R rated for exterior installation.

3.3 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed to assure proper operation.

B. Check for damage and tight connections prior to energizing transformer.

C. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

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SECTION 26 24 13

SWITCHBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Distribution switchboard.

B. Switchboard start-up.

C. ARC energy reduction Article 240-87.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. ANSI/IEEE C12.1 - Code for Electricity Metering.

C. ANSI C39.1 - Electrical Analog Indicating Instruments.

D. ANSI C57.13 - Instrument Transformers.

E. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.

F. NEMA KS 1 - Enclosed Switches.

G. NEMA PB 2 - Deadfront Distribution Switchboards.

H. NEMA PB 2.1 - Proper Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.

1.4 SUBMITTALS

A. Provide submittal as listed in Section 26 01 00.

B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and switchboard instrument details.

C. Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.

D. Test Reports: Indicate results of factory production tests.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

F. Manufacturer and Contractor shall verify the overcurrent protective device to match wire size as shown and noted in the bid documents.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1.

B. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site.

B. Deliver the switchboard shipping splits to be suitable to pass thru door or wall openings. Electrical Contractor shall be responsible to confirm switchboard dimensions to avoid any installation methods.

C. Accept switchboards on site. Inspect for damage.

D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. As scheduled on the drawings.

2.2 SWITCHBOARD

A. Distribution panel as detailed on the drawings.

B. Provide AIC rating to match the minimum utility fault current values.

2.3 ARC ENERGY REDUCTION

A. Furnish an energy reducing maintenance switch for a circuit breaker rated 1200 amps or higher.

2.4 SURGE PROTECTIVE DEVICE (SPD)

A. Furnish a factory installed spd suppression on all emergency generator distribution panels as scheduled.

B. Include a 3 pole circuit breaker or fusible branch switch if a remote mounted spd unit is required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install switchboard in locations shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1.

B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.

C. Provide generic arc flash warning label on all electrical distribution equipment in accordance with NEC 2023 requirements.

3.2 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed to assure proper operation.

B. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

C. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each, at test voltage of 1000 volts; minimum acceptable value for insulation resistance is 2 megohms.

D. Check tightness of accessible bolted bus joints using calibrated torque wrench.

E. Electrical Contractor shall pay all costs by the manufacturer’s technical services as necessary to reassemble the switchboard to maintain the UL listing or warranty.

F. Obtain switchboard start-up services from the manufacturer.

3.3 ADJUSTING

A. Adjust all operating mechanisms for free mechanical movement.

B. Tighten bolted bus connections in accordance with manufacturer's instructions.

C. Adjust circuit breaker trip and time delay settings to values indicated.

3.4 CLEANING

A. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

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SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Distribution panelboards.

B. Branch circuit panelboards.

C. ARC Energy reduction NEC 2023 Article 240.87.

D. Arc-fault circuit interrupter circuit breaker.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. NEMA AB 1 - Molded Case Circuit Breakers.

B. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

C. NEMA KS 1 - Enclosed Switches.

D. NEMA PB 1 - Panelboards.

E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

F. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

1.4 SUBMITTALS

A. Provide submittal as listed in Section 26 01 00.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for

storage, handling, protection, examination, preparation, installation, and starting of Product.

D. Panelboard submittal shall match drawing schedule arrangement. Submittal shall custom edit schedules to match design drawings.

E. Manufacturer and Contractor shall verify the overcurrent protective device to match wire size as shown and noted in the bid documents.

1.5 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. As scheduled on the drawings.

2.2 DISTRIBUTION PANELBOARDS

A. Panelboards: NEMA PB 1, circuit breaker type or fusible switch type per plan.

B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.

C. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses.

D. Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

E. Molded Case Circuit Breakers with Current Limiters: NEMA AB 1. Provide circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.

F. Current Limiting Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole.

G. Provide circuit breaker accessory trip units and auxiliary switches as indicated.

H. Cabinet Front: Surface type, fastened with concealed trim clamps, hinge and latch. Provide hinged door with flush lock. Finish in manufacturer's standard gray enamel.

2.3 BRANCH CIRCUIT PANELBOARDS

A. As scheduled on the drawings.

2.4 FUSES

A. Manufacturers:
1. Bussman, or equal.

B. Fuses 600 Amperes and Less: Dual element, current limiting, time delay, one-time fuse, 600 volt.

C. Fuses 601 Amperes and Larger: Current limiting, time delay one time fuse, 600 volt, UL Class L.

D. Interrupting Rating: 200,000 rms amperes.

2.5 ARC ENERGY REDUCTION

A. Furnish an energy reducing maintenance switch for a circuit breaker rated 1200 amps or higher.

2.6 ARC-FAULT CIRCUIT INTERRUPTER

A. Furnish listed combination type arc-fault circuit interrupter device for dwelling units and dorm rooms.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Height: 6 ft to top of panelboard; install panelboards taller than 6 ft with bottom no more than 4 inches above floor.

C. Provide filler plates for unused spaces in panelboards.

D. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

E. Provide engraved plastic nameplates under the provisions of Section 26 05 53.

F. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.

G. Arc-fault protection is required on all 120 volt branch circuits supplying 15 amp and 20 amp receptacles installed in dwelling units.

3.2 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed to assure proper operation.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

C. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

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SECTION 26 27 16

ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hinged cover enclosures.

B. Cabinets.

C. Terminal blocks.

D. Accessories.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.

C. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

1.4 SUBMITTALS

A. Provide submittal as listed in 26 01 00.

B. Product Data: Provide manufacturer's standard data for enclosures and cabinets.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 EXTRA MATERIALS

A. Provide two (2) of each cabinet key.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 HINGED COVER ENCLOSURES

A. As scheduled on the drawing.

2.2 CABINETS

A. As scheduled on the drawing.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive Work.

3.2 INSTALLATION

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

B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.

C. Install cabinet fronts plumb.

END OF SECTION

MAI: 2026-01014

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall switches.

B. Receptacles.

C. Device plates.

D. Floor box service fittings.

E. Poke-through service fittings.

F. Boiler Room emergency stop station.

G. Tamper resistant receptacles.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. NEMA WD 1 - General Requirements for Wiring Devices.

B. NEMA WD 6 - Wiring Device -- Dimensional Requirements.

C. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

D. ADA - Americans with Disabilities Act - As amended.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

.

PART 2 PRODUCTS

2.1 WALL SWITCHES

A. Manufacturers:
1. Pass & Seymour, Hubbell, Leviton or equal.

B. Description: NEMA WD 1, Heavy-Duty, AC only general-use snap switch.

C. Body and Handle: Color to be determined from standard colors by the Architect.

D. Ratings:
1. Voltage: 120/277 volts, AC.
2. Current: 20 amperes.

E. Boiler Emergency Power Off
1. Provide EPO station as scheduled on the drawings.

2.2 WALL DIMMERS

A. Manufacturers:
1. As scheduled on the drawings.

2.3 RECEPTACLES

A. Manufacturers:
1. Hubbell, Pass & Seymour, Leviton, or equal

B. Description: NEMA WD 1, Heavy-duty specification grade duplex receptacle.

C. Device Body: Color to be determined from standard colors by the Architect.

D. Configuration: NEMA WD 6, type as specified and indicated.

E. Convenience Receptacle: Type 5-20.

F. GFCI Receptacle: Convenience duplex receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

G. Damp and wet location receptacles shall be rated “WR”.

H. Tamper Resistant Receptacles
1. All 15 amp and 20 amp receptacles shall be listed tamper resistant as follows:
- Child care facilities.
- Preschools and elementary education facilities.
- Business offices, corridors, waiting rooms,
- Assembly occupancies, including gyms, skating rinks, and auditoriums.

2.4 WALL PLATES

A. Cover Plate: Stainless steel

B. Use stainless steel cover for food service areas.

C. Use “in use” weather proof metallic covers at exterior locations as indicated on the drawings to meet 2023 NEC Section 406.

D. Provide blank metal cover plates on abandoned boxes.

E. Provide stamped metal cover plate for unfinished spaces.

2.5 FLOOR MOUNTED SERVICE FITTINGS

A. As scheduled on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that outlet boxes are installed at proper height.

B. Verify that wall openings are neatly cut and will be completely covered by wall plates.

C. Verify that floor boxes are adjusted properly.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install devices plumb and level.

B. Install switches with OFF position down.

C. Install receptacles with grounding pole on bottom.

D. Connect wiring device grounding terminal to outlet box with bonding jumper or branch circuit equipment grounding conductor where specified.

E. Install plates on switch, receptacle, and blank outlets in finished areas.

F. Connect wiring devices by wrapping conductor around screw terminal.

G. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

H. Install protective rings on active flush cover service fittings.

I. Install the boiler emergency shutdown switch at each main boiler room area entrance.

J. Shared neutral are not permitted for lighting and power circuits.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Confirm with architectural drawings for counter casework, etc. details for wiring devices mounting heights.

B. Install wall switch 48 inches to top of box above finished floor.

C. Install convenience receptacle 16 inches to bottom of box above finished floor.

D. Install convenience receptacle 6 inches above backsplash of counter.

E. Install dimmer 48 inches to top of box above finished floor.

F. 18” mounting height is lieu of the 16” minimum specified is acceptable pending masonry course lines.

G. Electrical Trades shall review 2017 ICC/ANSI A117.1 for ADA requirements. Obtain a copy as required.

H. Refer to all other sections of the specification, drawings, and Architectural drawing for specific mounting requirements for clocks, receptacles shown in counters, work stations. Do not rely solely on the electrical drawings for this information. Division 26, 27 & 28 Contractor shall be responsible to review all project documentation and obtain all required information from the district.

I. Refer to section 28 31 00 and drawing notes for fire alarm device mounting heights.

3.5 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify that each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

END OF SECTION

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SECTION 26 28 13

FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fuses.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.4 PROJECT RECORD DOCUMENTS

A. Record actual fuse sizes.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Bussman or equal.

2.2 FUSE REQUIREMENTS

A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.

B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.

C. Main Service Switches Larger than 600 amperes: Class L (time delay).

2.3 CLASS RK1 (TIME DELAY) CURRENT LIMITING FUSES

A. Manufacturers:
1. Bussman or equal.

PART 3 EXECUTION

3.1 INSTALLATION

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

B. Install fuse with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

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SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fusible switches.

B. Nonfusible switches.

C. Fuses.

1.2 REFERENCES

A. NEMA KS 1 - Enclosed Switches.

B. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

C. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Type.

D. UL 198E - Class R Fuses.

1.3 SUBMITTALS

A. Provide submittal as listed in Section 26 01 00.

B. Product Data: Provide switch ratings and enclosure dimensions.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. As scheduled on the drawings.

2.2 ENCLOSED SWITCHES

A. Fusible Switch Assemblies: NEMA KS 1, Type Heavy Duty load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses.

B. Nonfusible Switch Assemblies: NEMA KS 1, Type Heavy Duty load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1.
1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 3R.

D. Disconnect switches serving the elevator main power must be a heavy duty type to meet the State of Michigan Elevator Code. Disconnect switch shall include auxiliary contacts for use by the elevator contractor to send a signal the main power disconnect is open.

2.3 FUSES

A. Manufacturers:
1. Bussman or equal.

B. Description: Dual element, current limiting, time delay, one-time fuse, 600 volt.

C. Interrupting Rating: 200,000 rms amperes.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install disconnect switches where indicated.

B. Install fuses in fusible disconnect switches.

C. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

D. Contractor shall confirm final elevator main power requirements to properly size the disconnect switch and fusing.

E. Electrical` Contractor shall be responsible to review the mechanical equipment schedules to determine if any factory installed switches are scheduled and noted as part of the equipment to minimize duplication by electrical trades.

F. Furnish and install a separate lockable fusible disconnect switch for the elevator car fan and light.

G. Furnish and install a lockable fusible disconnect switch for each boiler main incoming power disconnecting means to meet the State’s Boiler Code Division requirements.

END OF SECTION

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SECTION 26 29 13

ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manual motor starters.

B. Combination magnetic motor starters.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Type.

C. UL 198E - Class R Fuses.

D. NEMA AB 1 - Molded Case Circuit Breakers.

E. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

F. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

G. NEMA KS 1 - Enclosed Switches.

1.4 SUBMITTALS

A. Provide submittal as listed in Section 26 01 00.

B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

C. Test Reports: Indicate field test and inspection procedures and test results.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory

Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. As scheduled on the drawings.

2.2 MANUAL CONTROLLERS

A. As scheduled on the drawings.

2.3 POWER RELAYS.

A. As scheduled on the drawings.

B. Furnish and install the power relay for the new mechanical equipment as shown on the drawings to allow for interface by the BAS contractor.

2.4 COMBINATION MOTOR STARTERS

A. As scheduled on the drawings.

2.5 UNIT HEATERS

A. Provide manual motor starter as noted and shown on the drawing.

B. Electrical Trades shall install and wire all loose pump starter panels furnished as part of Mechanical Trades. Electrical Trades shall be responsible to determine what mechanical equipment will have loose equipment and include costs as part of the bid submitted. Contact the mechanical bidders to obtain all information. All control wiring shall be completed as part of the temperature control contractor bid.

2.6 BOILER IN-LINE CIRCULATING PUMPS

A. Provide manual motor starter and power relays as noted and shown on the drawing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.

B. Install enclosed controllers plumb. Provide supports in accordance with Section 26 05 29.

C. Height: 5 ft to operating handle.

D. Install fuses in fusible switches.

E. Select and install overload heater elements in motor controllers to match installed motor characteristics.

F. Provide engraved plastic nameplates under the provisions of Section 26 05 53.

G. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.2 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed for proper operation.

B. Inspect and test each enclosed controller to NEMA ICS 2.

END OF SECTION

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SECTION 26 29 34

ENCLOSED CONTACTOR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General purpose contactor.

1.2 REFERENCES

A. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

B. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

C. 2017 National Electrical Code.

1.3 SUBMITTALS

A. Submit as listed in Section 26 01 00.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Provide Products listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Contactor as scheduled on the drawing.

2.2 CONTACTOR

A. Coil Voltage: As scheduled on the drawing.

B. Poles: As scheduled on the drawing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

END OF SECTION

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SECTION 26 43 13

SURGE PROTECTIVE DEVICES FOR LOW VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surge protective device.

1.2 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

1.3 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.4 REFERENCES

A. UL 1449 4th Edition listing and classification and clamping voltages.

B. ANSI/IEEE C62.41/62.45 certified documentation of performance testing.

C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

1.5 SUBMITTALS

A. Provide submittals as listed in Section 26 01 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. As scheduled on the drawings.

B. Service Entrance, Mdp and Panelboard Surge Protective Devices

C. SPD Description: Units shall have the following features and accessories:
1. Engineered solid state arrays of nonlinear voltage dependent individually fused and thermally protected metal oxide varistors with matched operating characteristics.

2. The suppression system shall not utilize silicon avalanche diodes (SADs), selenium cells or other components which might short circuit the line, leading to interruption of normal power.
3. Short circuit current rating: 200 kAIC.
4. Nominal Discharge Current Rating: 20 kA $I_{(n)}$.
5. Internal connections: All full magnitude transient currents shall be conducted utilizing low impedance copper bus bars.
6. Fabrication using bolted compression lugs for internal wiring.
7. Redundant suppression circuits.
8. Red and green LED indicator lights for power and protection status.
9. Audible alarm to indicate when protection has failed.
10. Surge event operations counter (Service Entrance device requirement only).
11. Form C contacts; 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.

D. Peak Surge Current Rating for Service Entrance devices: 240 kA per phase.

E. Peak Surge Current Rating for Distribution Panel devices: 150 kA per phase.

F. Peak Surge Current Rating for Branch Panelboard devices: 100kA per phase.

G. UL 1449 4th Edition Voltage Protection Rating (VPR) shall be as follows:
1. Line to Neutral:
   a. 480Y/277: 1200V
   b. 208Y/120: 700V
2. Line to Ground:
   a. 480Y/277: 1200V
   b. 208Y/120: 700V
3. Neutral to Ground:
   a. 480Y/277: 1200V
   b. 208Y/120: 700V
4. Line to Line:
   a. 480Y/277: 2000V
   b. 208Y/120: 1200V

2.2 SERVICE CONDITIONS

A. Rate SPDs for continuous operation under the following conditions unless otherwise indicated:

B. Maximum Continuous Operating Voltage per UL 1449 4th edition:
1. 480Y/277: 15% allowable fluctuation, 320V
2. 208Y/120: 25% allowable fluctuation, 150V

C. Operation Temperature: 0 to 120 deg F

D. Humidity: 0 to 95%, non-condensing.

E. Altitude: Less than 10,000 feet above sea level.

2.3 ENCLOSURES

A. The specified system shall be provided in a NEMA-rated enclosure suitable for the environment.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

A. Conductors between suppressor and point of attachment to service equipment shall be sized in accordance with manufacturer’s recommendations and conductor lengths shall be as short as possible, not to exceed 36 inches for Service Entrance and 18 inches for Distribution and Branch Panels. Do not bond neutral and ground.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Verify that electrical wiring installation complies with manufacturer's installation requirements.

END OF SECTION

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SECTION 26 51 00

INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires per schedule.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

B. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

C. NFPA 101 - Life Safety Code, current adopted edition.

D. 2021 Michigan Energy Code.

E. ASHRAE 90.1 2019 Edition.

F. LED Standards LM 79 and LM 80.

1.4 SUBMITTALS FOR REVIEW

A. Provide submittal as listed in Section 26 01 00.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide dimensions, ratings, and performance data.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Conform to requirements of NFPA 101.

C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

D. 2021 Michigan Energy Code.

PART 2 PRODUCTS

2.1 LUMINAIRES

A. Furnish Products as scheduled on the drawings.

2.2 LED DRIVERS

A. LED drivers shall include a factory disconnecting means in accordance with 2023 NEC 410-130G.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

B. Support luminaires independent of ceiling framing.

C. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.

D. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

E. Exposed Grid Ceilings: Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips at a minimum of (4) points of attachment to prevent movement.

F. Install recessed luminaires to permit removal from below.

G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

H. Install clips to secure recessed grid-supported luminaires in place at a minimum of (4) points of attachment to prevent movement.

I. Install wall mounted luminaires at height as indicated on Drawings and/or architectural drawings.

J. Install accessories furnished with each luminaire.

K. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

L. Bond products and metal accessories to branch circuit equipment grounding conductor.

M. Luminaires specified with factory installed batteries shall be wired to the local lighting circuit hot conductor and also the ahead of any controls in addition to local lighting controls per manufactures wiring requirements.

3.2 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING

A. Contract Closeout: Division 1: Adjusting installed work.

B. Aim and adjust luminaires as indicated or as directed.

C. Position exit sign directional arrows as indicated.

3.4 CLEANING

A. Contract Closeout: Cleaning installed work.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosures.

D. Clean photometric control surfaces as recommended by manufacturer.

E. Clean finishes and touch up damage.

3.5 DEMONSTRATION AND INSTRUCTIONS

A. Replace light fixtures with non-working LED’s, broken or discolored lens.

3.6 PROTECTION OF FINISHED WORK

A. Contract Closeout: Protecting installed work.

3.7 SCHEDULES

A. Refer to Drawings.

END OF SECTION

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SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Exterior luminaires and accessories.

B. Watertight wiring connectors.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. LED Standards LM 79 and LM 80.

B. ANSI O5.1 - Specifications and Dimensions for Wood Poles.

C. IES 10th Edition.

D. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

E. 2021 Michigan Energy Code.

1.4 SUBMITTALS FOR REVIEW

A. Provide submittal as listed in Section 26 01 00.

B. Shop Drawings: Indicate dimensions and components for each luminaire which is not a standard Product of the manufacturer.

C. Product Data: Provide dimensions, ratings, and performance data.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

C. Michigan Uniform Energy Code.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Material and Equipment: Transport, handle, store, and protect products.

B. Store and handle solid wood poles in accordance with ANSI O5.1.

1.7 COORDINATION

A. Coordination, refer to Division 1.

B. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

PART 2 PRODUCTS

2.1 LUMINAIRES AND ACCESSORIES

A. Furnish Products as scheduled on the drawings.

2.2 WATERTIGHT WIRING CONNECTORS.

A. Furnish removal connector assembly either fused or non-fused.

B. Provide in-line connector type for single circuit application.

C. Provide Y type connector to permit splitting of the circuit.

D. Acceptable manufacturers for in line or y connectors: Buchanan 84, 65 Series or equal by Homac.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for improper connections and operation.

B. Measure illumination levels to verify conformance with performance requirements.

C. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.2 ADJUSTING

A. Contract Closeout: Adjusting installed work, refer to Division 1.

B. Aim and adjust luminaires to provide illumination levels and distribution as specified.

3.3 CLEANING

A. Contract Closeout: Cleaning installed work, refer to Division 1.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosure.

D. Clean photometric control surfaces as recommended by manufacturer.

E. Clean finishes and touch up damage.

3.4 PROTECTION OF FINISHED WORK

A. Contract Closeout: Protecting installed work, refer to Division 1.

B. Relamp luminaires which have failed lamps at Substantial Completion.

3.5 SCHEDULE

A. Refer to drawings.

END OF SECTION

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SECTION 27 05 28

PATHWAYS FOR COMMUNICATION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Voice/Data raceway.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. EIA/TIA-568 - Commercial Building Wiring Standard.

B. EIA/TIA-569 - Commercial Building Standard for Telecommunication Pathways and Spaces.

C. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

1.4 SYSTEM DESCRIPTION

A. Telephone Service Entrance Pathway: Nonmetallic from point of telephone utility connection at property line to building service terminal backboard.

B. Backbone Pathway: Conform to EIA/TIA 569 using combination of conduit and sleeves as indicated.

C. Horizontal Pathway: Conform to EIA/TIA 569, using raceway, backboards as indicated.

D. Voice/Data wiring: By Owner.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Record actual locations and sizes of pathways and outlets.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of 2025 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Furnish Products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

Section Not Used

PART 3 EXECUTION

3.1 INSTALLATION

A. Install raceways in accordance with EIA/TIA 568.

B. Support raceways and cabinets under the provisions of Section 26 05 29.

C. Install recessed cabinets flush with wall finishes, and stub 5 empty 1 inch conduits to accessible location above ceiling at each location.

D. Install polyethylene pulling string in each empty voice conduit over ten feet in length or containing a bend.

E. Install a #6 AWG green ground wire to backboard from service entrance ground bar in main panel.

F. Voice/data outlet minimum mounting heights shall match duplex receptacles. Refer to Section 26 06 24.

END OF SECTION

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SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Data patch panel.

B. Cable management.

C. Voice/data/terminations.

D. Wall station faceplate.

E. Category 6 cable.

F. Voice cable.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. ANSI EIA/TIA-568-B.2, 568-B.2, 568-B.3 - Commercial Building Wiring Standard.

B. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

1.5 PROJECT RECORD DOCUMENTS

A. A record shall be compiled and provided to the owner in compliance with the ANSI EIA/TIA 606-A standard.

B. Each horizontal cable shall be tested in accordance with ANSI EIA/TIA 568-B.2 to verify C6 compliance. Passable test per cable segment shall be submitted to the Owner.

1.6 SUBMITTALS

A. Provide submittals as listed in Section 26 01 00. The submittal shall be prepared by manufacturer's representative. Supply house or contractor's prepared submittals will be returned

B. Submittals shall include the total IDF rack layout include patch panels, 110 blocks, power strips, cable management, cable TV distribution blocks, relay rack and all component cut sheets. Mark or arrow cut sheets with catalog numbers. Failure to comply will be cause to return the submittals for corrections at no delays or extra costs to the District.

1.7 SCOPE OF WORK, BUT NOT LIMITED TO THE FOLLOWING

A. Furnish and install Contractor furnished system components for a complete operating and tested system.
   1. General Requirements:
      a. Contractor shall relocate, install new racks or modify the existing MDF rack and IDF frame racks to permit additional patch panels, patch cords, CAT 6 cabling. Include all terminations to serve the new voice and data.
   2. Specific Project Requirements:
      a. Remove all existing voice and data cabling from the station side outlets, to the existing distribution frames. Removal shall include all wiring installed from the ceiling space.
      b. Furnish and install the fire rated wireway specified for cables passing thru fire rated walls as noted and shown on the drawings.
      c. Furnish and install multi-port faceplate with modular jacks suitable for in-line device mounting.
      d. Provide J hooks, D rings in addition to the wire mesh cable tray. Nylon ties for supports or bundling of new cables are not permitted. Nylon ties are accepted for existing cables that are feasible to be retrained into the new tray.
      e. Complete all new voice, data and cable TV cables that exits from the MDF or IDF frames to serve the station side outlets.
      f. Complete the relocation of the MDF or IDF frames as noted or shown on the drawings. Provide new or additional frames and add patch panels to the existing frames as required for a complete new upgraded system.

1.8 PERMITS

A. Contractor shall obtain and pay all permit costs and inspection fees for voice and data device drops.

1.9 PRE-START CONFERENCE

A. The Contractor shall be responsible to set up a pre-start meeting with the construction manager or the Owner's technology vendor to determine installation

phasing and actual work installation methods prior to starting this phase of the work.

PART 2 PRODUCTS

2.1 PATCH PANEL

A. Hubbell Speedgain C6 or equal shall be provided to meet school standard.

2.2 PATCH CORDS (Field confirm length). 3'-10" minimum, 10'-0" standard. However, a longer length shall be furnished for a complete operating system.

A. Blue-Data

2.3 WALL STATION FACEPLATE

A. Flush mounted single gang, minimum 4 port. Include blue, C6, RJ45, modular jack insert for data. Include white, C6, RJ45, modular jack insert for voice. Contractor to review the drawing for each station to determine quantity and type. Faceplate covers shall be office white.

2.4 IDF/MDF RACK EQUIPMENT

A. Contractor shall furnish, install and terminate patch panels, cable management components, labeling, wall station faceplate terminations and certifications to match the district's existing installation. Contractor shall review the district's existing rack installation to gain knowledge and technical information methods for design, layout and installation for this project's requirements. Network/communication shop drawing submittals shall include cut sheets of the rack, patch panel, rack layout, face plates, modular jacks, CAT 6 wiring and patch cords.

B. Contractor shall be responsible to design, layout, and arrange the rack equipment and associated components for a complete system installation. Contractor shall also be responsible to make all field adjustments as directed by the district as well.

C. Provide components to meet school standards. Hub switches shall be furnished and installed by the school district.

2.5 CATEGORY 6 CABLE

A. 24 awg solid copper, FEP insulation, type MPP/CMP. 4 pair, plenum cable and rated for cable tray installation. Minimum performance 350 MHz.

Blue jacket - data

PART 3 EXECUTION

3.1 INSTALLATION

A. Furnish and install all voice/data components in accordance with plans and specifications.

B. Contractor shall complete all terminations, testing and certifications in accordance with ANSI EIA/TIA 568-B.2 standard. Testing includes all components: cable, patch cords, equipment cords and connecting hardware for copper cable. Fiber optic cable shall be tested to verify length, continuity, and measure loss and/or attenuation.

C. Label data rack equipment, closet side, station side cables, faceplates.

D. Firestop all wall sleeve openings conduits and cables installed through the sleeve.

E. All terminations and test each cable in accordance with the ANSI EIA/TIA 568-B.2 standard. Passable test results per cable shall be provided to the Owner. Written final documentation shall be furnished at closeout of project and serve as part of the as-built records.

F. Network/Communication cables shall not exceed bend radius or pulling tension. Obtain manufacturer's data prior to starting this phase of the work.

G. Review the school's facility wide standards voice/data rack installation to gain a knowledgeable insight and technical installation methods for this project.

H. Contractor shall install data C6 UTP cables from each work station to patch panel in accordance with plans and specification. Each cable shall be a "home run" back to telecommunications room and/or IDF. Splices are not acceptable.

I. Provide modular jack RJ45 type or as specified.

J. Furnish and install cable management devices either D-rings, or J hooks above accessible ceilings. Provide EMT conduit for physical protection of all low voltage system cables in exposed areas. Use the cable tray where ever available as noted or shown on the drawings.

K. Provide firestop caulk for all conduit sleeves and fire rated wireway as shown on the drawings.

L. Arrange with the Owner during the bid phase to visit an existing facility to review rack configuration, equipment layouts, labeling, patch cords, faceplate modular jack color and labeling scheme.

M. Provide cable maintenance loops at the racks for all voice and data cables.

N. Minimally compliant cable and connectivity is not acceptable.

END OF SECTION

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SECTION 27 51 16

PUBLIC ADDRESS SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Public Address equipment.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 Michigan Electrical Code Rules Part 8, 2017 ICC/ANSI A117.1 and local code requirements.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

C. Section 26 05 33.16 – Boxes for Electrical Systems.

1.4 SYSTEM DESCRIPTION

A. Scope as follows, but not limited to the following. Extend the existing Public Address system into the new administrative addition. Refer to the drawings for specific part numbers. New speakers and front end communication back to the nearest data rack as denoted on the drawings.

1.5 SUBMITTALS

A. Provide submittals as listed in Section 26 01 00.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit as part of 26 01 00 requirements.

1.7 REGULATORY REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Furnish products listed or labeled to conform to requirements of 2023 National

Electric Code, State of Michigan Electric Code, and local authority having jurisdiction.

C. Conform to requirements of Federal Communications Commission.

PART 2 PRODUCTS - Rauland is base bid.

2.1 PUBLIC ADDRESS MASTER UNIT

A. Existing to remain

2.2 MULTI-PURPOSE AMPLIFIER

A. 250 watts, internal transformer, level control, outputs on screw terminals, variable speed fan for quiet operation rack mountable. BIAMP MPA 250.

B. Furnish amplifier quantity as required for a complete system.

2.3 WALL MOUNT RACK

A. Existing to remain

2.4 TELEPHONE INTERFACE MODULE

A. Provisions for selected phone extension usage.

B. Interface capability to the PA master unit.

C. Category 5E wiring usage for phone ports.

D. Suitable for board mounting within the PA master unit. Rauland ICS2TIM.

E. The phone equipment requires either a PBX central office port or an analog station port. The ports shall be capable of passing DTMF tones and provide a disconnect pulse to permit a “tie-line” interface between the public address and phone system. The district shall pay phone vendor costs to complete these component options for the “tie-line” interface.

2.5 SPEAKER ASSEMBLY

A. Refer to drawings for selections

B. Speaker Backbox
1. Plenum rated, seamless, one-piece steel construction, coated and painted finishes. Conduit knockouts, enclosure shall include fire retardant damping pad, enclosure shall be round type suitable for recessed installation. Rauland ICC-ERD.

C. Speaker Support Pan
1. Steel construction, built-in backbox mounting tabs, support bridge to accept round or square screw mounting grilles. Rauland ICC-SSB.

D. Speaker Baffle

1. White epoxy finish, steel construction, two-step round and contoured. Rauland ICC-CA10 assembly.

E. Wire Guard
1. Provide wire guards for the Gym installation.

2.6 WIRING

A. New branch speaker wiring shall be plenum rated. Provide 2 pair 22 awg, 1 pair shielded for classrooms and offices, 1 pair #18 awg for corridor. West Penn or equal is an acceptable manufacturer.

B. Administration phone. Provide a voice grade CAT3 cable as specified in this specification section.

C. Provide 25 pair Category 3 voice grade cable as required junction to the PA rack unit for the extension from West Penn cables or approved equals.

D. Provide 1 pair 18 gauge for corridor and exterior speakers. West Penn or equal is an acceptable manufacturer. Provide a separate speaker circuit zone for the exterior speakers.

E. Public address wiring shall utilize the low-voltage cable tray, or other cable management methods above the accessible ceiling space. Provide conduit drops for any wall mounted speakers.

2.8 EXTERIOR SPEAKER

A. Refer to drawings

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Mounting Heights: Confirm locations of outlet boxes as shown on the drawings. Final mounting height as advised by the Architect/Owner.

C. Provide protection for exposed cables where subject to damage.

D. Division 26 Contractor shall furnish and install new PA unit, telephone interface, speakers, backboxes, and wiring as noted and shown on the drawings.

E. Install exterior speaker as noted and shown on the drawings.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems to assure proper operation.

B. Provide a manufacturer technical staff for start-up and commission.

C. Include 8 hours of training with the bid which shall be split into two separate, 4 hour training sessions. These training sessions shall be on different days, which will require two separate trips by the instructor. The training shall take place at the Owner's facility.

END OF SECTION

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SECTION 28 46 13

FIRE ALARM SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. New voice evacuation point addressable main fire alarm panel, devices, and new NAC panels.

1. Fire alarm system performance specification.
   a. Contractor shall be responsible to obtain engineering and AutoCAD from the fire alarm manufacturer to design a new system. Devise an existing system and install a complete fire alarm system.
   b. Contractor shall submit and pay all fees for plan review, 50% inspection, final inspection and complete and submit all associated documents.
   c. Contractor shall be responsible for system check-out, start-up and on-site Owner training.

B. Fire alarm system shall not be limited to: Manual pull stations, magnetic door holders, duct smoke detectors, ceiling smoke detectors, audio/visual devices and visual devices. Include all associated code mandated components, wiring for a complete operating system.

C. Fire alarm ADA signaling devices.

D. Fire alarm wiring.

E. Unit Prices: Provide a unit price for complete device installation as listed: Manual pull stations, audio/visual devices, smoke detectors, duct smoke detectors, conduit, backboxes and wiring. Refer to the Bid Proposal Form for associated requirements.

F. Combination smoke/fire dampers shall be furnished and installed as part of Mechanical Trades bid. It shall be the responsibility of the Electrical Trades to review the mechanical drawings for damper locations. Do not rely solely on the electrical drawings.

G. Fire protection system. Electrical Trades shall complete all flow and tamper switch wiring to the fire alarm system. The flow and tamper switches shall be furnished and installed as part of the fire protection contractor's bid. Electrical Trades shall furnish and install a flush mounted backbox, an exterior horn/strobe and wiring to the fire alarm system. Electrical Trades shall be responsible to contact the fire protection contractor to confirm flow and tamper switch quantities and locations, and include all costs.

H. The fire alarm vendor shall be responsible to review the Architectural door schedules and hardware specification section to include all magnetic door holder devices. Include all fire alarm panel points.

I. Complete fire alarm wiring to the flow and tamper switches.

J. The Fire Alarm vendor shall include in their bid any cost for requesting AutoCAD backgrounds for their use from the Architect or Engineer. The cost will be $150.00 for the first plan, and $50.00 for each additional plan that may be requested for AutoCAD use. A waiver of responsibility for the Architect and Engineer related to Contractor use of the CAD files shall be signed by the Fire Alarm vendor.

K. Fire alarm system interface to egress lighting to meet Chapter 7 Life Safety Code Article 7.8 requirements.

1.2 RELATED SECTIONS

A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 State of Michigan Code Rules Part 8, 2017 ICC/ANSI 117.1 and local code requirements.

B. NFPA 72 - Current adopted code.

C. State of Michigan – Bureau of Fire Services for Fire Alarm Plan Review and Inspections.

D. Local authorities having jurisdiction.

E. State of Michigan, 2016 School Rules.

F. Underwriters Laboratories Inc.

G. National Fire Protection Association Standards
1. NFPA 13 – Installation of Sprinkler Systems.
2. NFPA 15 – Water Spray Fixed Systems.
3. NFPA 16 – Deluge Foam Water Systems.
4. NFPA 72 – National Fire Alarm Code.
5. NFPA 101 – Life Safety Code.
6. NFPA 720 – Standard for Installation of CO Detection.

H. All equipment shall be approved by Underwriters Laboratories Inc. (UL) for its intended purpose for the following standards as applicable.
1. UL864 UOJZ - Control units for fire protective signaling systems local signaling unit.
    a. Central station signaling protected premises unit.

b. Remote signaling protected premises unit.
2. UL2075 - CO detectors connected to face.
3. UL864 SYZV - Releasing device control unit (water release only).
4. UL268 - Smoke detectors for fire protective signaling systems.
5. UL268A - Smoke detectors for duct application.
6. UL217 - Smoke detectors for single stations.
7. UL521 - Heat detectors for fire protective signaling systems.
8. UL228 - Door holders for fire protective signaling systems.
9. UL464 - Audible signaling appliances.
10. UL1638 - Visual signaling appliances.
11. UL38 - Manually activated signaling boxes.
12. UL346 - Waterflow indicators for fire protective signaling systems.
13. UL1481 - Power supplies for fire protective signaling systems.

1.4 AMERICANS WITH DISABILITIES ACT (ADA)

A. All visual notification appliances and manual pull stations shall comply with the requirements with ADA.

1.5 SUBMITTALS

A. Provide submittal as listed in Section 26 01 00. Submittal cut sheets shall be arrowed or marked with catalog numbers. Failure to comply will be cause for returning submittal for corrections at no delays or extra cost to the Owner.
1. Plan drawings showing the locations (with room names and numbers) of the system components, including any adjustments in the quantities and locations of initiating devices and notification appliances to meet code requirements.
2. Riser diagram showing system components, interconnecting wiring and connections to other building systems and equipment.
3. Wiring diagrams showing manufacturer and field connections at component terminals, complete with conductor color codes and wire numbers.
4. System configuration list showing inputs, outputs, device addresses and custom location labels, device configurations and program logic.
5. Submit bill of materials, and not part of the submittal, with O&M Manuals.
6. Catalog pages showing system components.
7. System battery sizing calculations.
8. Power supply, amplifier and circuit sizing calculations.
9. Door hold-open power supply sizing calculations.

B. Shop Drawings: Provide control panel layout and system wiring diagram showing each device and wiring connection required.

1.6 PROJECT RECORD DOCUMENTS

A. Record actual locations for complete fire alarm system.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit as specified.

B. Operation Data: Operating instructions.

C. Maintenance Data: Maintenance and repair procedures.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of 2021 Michigan Building Code, 2023 National Electrical Code, 2023 State of Michigan Code Rules Part 8, 2009 ICC/ANSI 117.1 and local code requirements.

B. NFPA 72 - Current adopted edition.

C. NFPA 101 - Life Safety Code, current adopted edition.

D. State of Michigan, Bureau of Fire Services for Plan Review and Inspections.

E. Local authorities having jurisdiction.

F. State of Michigan, 2016 School Rules.

G. NFPA 90A Current Adopted Edition.

H. NFPA 92A Current Adopted Edition.

I. NFPA 92B Current Adopted Edition.

J. All equipment shall be approved by Underwriters Laboratories Inc. (UL) for its intended purpose for the following standards as applicable.
   1. UL864 UOJZ - Control units for fire protective signaling systems local signaling unit.
      a. Central station signaling protected premises unit.
      b. Remote signaling protected premises unit.
   2. UL2075 - CO detectors connected to face.
   3. UL864 SYZV - Releasing device control unit (water release only).
   4. UL268 - Smoke detectors for fire protective signaling systems.
   5. UL268A - Smoke detectors for duct application.
   6. UL217 - Smoke detectors for single stations.
   7. UL521 - Heat detectors for fire protective signaling systems.
   8. UL228 - Door holders for fire protective signaling systems.
   9. UL464 - Audible signaling appliances.
   10. UL1638 - Visual signaling appliances.
   11. UL38 - Manually activates signaling boxes.
   12. UL346 - Waterflow indicators for fire protective signaling systems.
   13. UL1481 - Power supplies for fire protective signaling systems.

1.9 SCOPE OF WORK

A. This bid package shall include fire alarm panel, all devices and associated NAC panel, wiring and system certification ready for interconnection to one main fire alarm control panel, and remote annunciator panel as specified.

B. Provide fire alarm wiring and a 120 volt circuit to any combination smoke/fire dampers as shown on the Mechanical drawings. Electrical Trades shall be responsible to review the Mechanical drawings in addition to the Electrical plans. Mechanical plans shall govern damper location. Interwire to the associated duct smoke detector in accordance with the manufacturer's wiring instructions. Duct smoke detector shall be provided and wired by Electrical Trades, unless specifically listed on the damper schedules.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. JCI/Simplex, Siemens, National Time, Honeywell, Gamewell or Edwards.

2.2 OPERATION

A. The operation of any manual pull station, flow switch, tamper switch, smoke detector, duct smoke detector, shall cause the sounding of all alarm horns on a temporal pattern basis, sequential flashing of system strobes, activate common alarm relay contacts on the control panel and indicate on the control panel's LCD display the zone and type of device sounding the alarm.

B. In addition, the operation of any duct smoke detector shall shut down its associated fan or damper motor. Complete interwiring between detector and mechanical equipment control panel.

C. Refer to the current adopted NFPA 72 Fire Alarm Code for the allowable detector distance and location from the pair of doors.

D. The operation of the panel mounted alarm silencing switch will turn off all horns but the strobes will continue to flash until the device actuating the alarm is reset to its normal position and the panel mounted system reset button is operated, at which time the system will return to its normal stand by (supervisory) mode.

E. Any system trouble condition such as an open circuit or ground condition will activate a common trouble LED and indicate on the control panel LCD display the exact zone, circuit or internal panel condition causing the trouble condition. Correction of the trouble source will return the panel to its normal standby mode.

F. Initiating device circuits shall be two-wire style B, and horn or strobe circuits shall be two-wire style Y utilizing end of line resistors for circuit supervision. All wiring to initiating and signaling devices shall be looped and continuous to the end of line resistor on its respective circuit. T-tapping is not permissible.

G. The fire alarm control panel shall communicate with each addressable initiating and control divide individually via shielded twisted pair signaling line circuits.

H. Each signaling line circuit shall be capable of accessing up to 127/250 addressable devices.

I. Each signaling line circuit shall allow up to 10,000 feet of wire length to the furthest addressable device.

J. Communications shall be completely digital and shall include parity data bit error checking routines for address codes and check sum routines for the data transmission protocol.

K. Each device shall be uniquely identified by the device address.

L. There shall be no limit to the number of initiating devices which may be activated simultaneously.

M. Each device shall be individually annunciated at the panel. Annunciation shall include the following conditions for each device.
1. Alarm, supervisory or trouble condition.
2. Open, short or ground.
3. Device failure or incorrect device installed.

2.3 FIRE ALARM CONTROL PANEL

A. New point addressable suitable for voice evacuation sized properly with a minimum of 30% spare capacity.

B. Provide a fire alarm control panel with the following:
1. Digital display.
2. Multiple pushbutton keypad.
3. LED status indicating lights.
4. Audible status signals.
5. Output relays.
6. Battery charger and batteries.
7. RS-232 communications card.

C. Evaluate and document the appropriate notification appliance circuit class designation.
1. In general, provide Class B notification appliance circuits.
2. Size the control panel power supplies, amplifiers, and batteries for 25 percent spare capacity calculated with, 1 watt speaker loads, and 150 ma strobe light loads.
3. Provide sufficient spare capacity on each notification appliance circuit for an additional 25 percent of notification appliances.

D. The system shall supervise the following circuits and components:
1. Initiating device circuits.
2. Signaling line circuits.
3. Notification appliance circuits.
4. Addressable initiating and control devices.
5. Control output wiring.
6. Auxiliary control switches.
7. System, NAC panels, remote annunciator, and remote microphone.
8. Primary power supply.
9. Secondary power supply.

E. The system shall be capable of being programmed by the Owner on site to accommodate expansion or sequence of operation changes.

F. Provide 120 volts AC primary power to the system.

G. Provide a control panel battery charger capable of fully charging a 200 amp-hour battery within 24 hours.

H. Provide sufficient secondary power battery capacity to operate the entire system (except the door hold-open devices) upon the loss of primary power for a period of 24 hours in a normal supervisory mode followed by 5 minutes of evacuation alarm operation.
   1. When emergency voice/alarm communications is provided, provide sufficient battery capacity for 24 hours of operation in a normal supervisory mode followed by 15 minutes of voice/alarm operation.
   2. The system shall automatically transfer to and from the secondary power batteries upon an interruption of primary power without initiating a nuisance alarm.
   3. The system shall delay initiating a trouble condition for two seconds upon a transfer to or from primary power to avoid nuisance trouble conditions during emergency generator testing.

I. Provide smoke and heat detectors as required by code and as shown, including the following.
   1. Provide a smoke detector in each mechanical, electrical, telecommunications, daycare rooms, and associated egress corridors.
   2. Provide duct smoke detectors where required by code. When not in plain view or when more than 10 feet above the floor, provide duct detector remote alarm indicators and test switches mounted in plain view at 48 inches above the floor.

J. Provide sufficient audible notification appliances to achieve a sound level of 15 dBA above ambient sound level, but not less than 60 dBA nor more than 110 dBA in all occupiable spaces. The sound level in mechanical rooms shall be not less than 90 dBA. The sound shall be a three-pulse temporal pattern evacuation tone.

K. Provide visual notification appliances in accordance with the intensity and spacing requirements of NFPA 72.
   1. Provide speaker/strobes in accordance with plans and specifications.
   2. Synchronize strobes.

L. Provide individually addressable monitor modules to monitor non-addressable initiating devices and status contacts of other systems.
   1. Monitor modules shall use Class B initiating device circuits to monitor the initiating devices and status contacts.

M. Provide panel auxiliary relay contacts and individually addressable control module contacts, including the required panel control logic programming, to interface with control circuits of other systems and equipment.

1. Provide normally closed duct smoke detector contacts to shut down ventilation systems.

N. Assign each initiating device and control module a unique device address. Label each device with its unique address using a clear adhesive backed nylon or Mylar tape with black text. Install the label on the base of any device with a removable or replaceable head.

O. Label each initiating device and control module that describes the type, room number/name and exact location of the device.

P. Provide transient voltage surge suppression for the system.

2.4 DEVICES (all point addressable type that is compatible to the main panel)

A. **Manual Pull Stations:** Individually addressable, suitable for two wire operation, with a high impact red Lexan body and raised white lettering. Stations shall include an ADA compliant single action operating mechanism with a mechanical latch to hold an operated station open until reset.
1. Reset shall be accomplished through use of a key common to the panel or a small flat-blade screwdriver. Stations which use allen wrenches or special tools to reset are not acceptable. The point of reset shall be front accessible so stations with tamper-resistant covers can be reset easily.

B. **Smoke Detectors:** Provide photoelectric type with two wire base for mounting to a 4” octagon box. Furnish smoke detectors for control of the magnetic door holder as shown and noted on the plans. Refer to the current adopted NFPA 72 Fire Alarm Code for the allowable detector for locations.

C. **Duct Smoke Detectors:** Individually addressable and consist of a housing, sampling tubes, a baffle and a detachable detector head. Duct detectors shall include an alarm LED, a local test switch, and an auxiliary SPDT relay for ventilation system control. Duct detectors shall be resettable by actuating the panel reset pushbutton. The sampling tubes shall be capable of being cleaned through the housing cover.
1. The detector heads shall be photoelectric as specified above, but shall be capable of accepting ionization detector heads.
2. Duct detectors shall include remote alarm indicators and test switches shall be installed in readily accessible locations.

D. **Strobes:** As shown for proper illuminance, clear Lexan lens with red "FIRE" or international fire symbol lettering, capable of being synchronized, and capable of wall or ceiling mounting.

E. **Magnetic Door Holder:** Flush wall unit. Minimum 25 pound holding force, 120 volt operation. Furnish addressable relay for each pair of doors, also include the door plate with holder assembly. Refer to door hardware schedule for additional project requirements, and for holder type. The schedule shall govern and the holders shall be provided, installed and wired to the fire alarm panel.

F. **Audio/Visual and Visual Units:** For ceiling installation shall include vertical lettering. Horizontal lettering is not acceptable.

G. Fire alarm panel contact for egress lighting interface to meet Chapter 7 Life Safety Code Article 7.8 requirements.

H. **Speakers:** Rated 125 to 12,000 Hertz, include four taps rated at from 1/4 to 2 watts, produce a sound level of 82 dBA at 10 feet when set at the 1/2 watt tap, and with a semi-flush body capable of wall or ceiling mounting.

1. Speakers for locations with high ambient noise may be high efficiency horns rated 500 to 6,000 Hertz minimum, 10 watts minimum, include four or more taps, produce a sound level of 106 dBA minimum at 1 meter when set at the 1 watt tap, and be capable of wall or ceiling mounting.
2. Combination speaker/strobes shall consist of the speakers and strobes as specified in this section, but combined on a single mounting plate. Combination units used outdoors and in wet areas shall be waterproof and mounted to waterproof back boxes.

I. Emergency voice/alarm communications shall include audio control modules for evacuation tone and voice message generation, controls to choose total building or selected areas communications, audio amplifiers, a local microphone, and a remote microphone at each remote annunciator. All of the components except for the remote microphones shall be located in or adjacent to the fire alarm control panel.

J. The audio control module default mode shall provide for automatic total building fire alarm evacuation. The evacuation tone shall consist of a three-pulse temporal pattern followed by a pre-recorded fire alarm voice message. At the end of each voice message, the evacuation tone shall resume. The evacuation tone and voice message shall sound alternately until the alarm silence pushbutton at the fire alarm control panel or remote annunciator has been pressed. Audio tones and voice messages shall be digitally transmitted between nodes.

K. The audio control modules shall provide for manual total building or selected area live voice communications. Upon keying of the local or a remote microphone, a three second continuous alert tone shall sound over the speakers indicating a live voice message will occur.

L. The evacuation and alert tones shall be digitally generated by programmable software so that changes can be made without component rewiring. The pre-recorded voice messages shall be stored digitally in non-volatile memory.

M. Audio amplifiers shall have a frequency response of 125 Hz to 12,000 Hz minimum.

N. **Microphones:** Hand-held, push-to-talk, noise-canceling type with a frequency range of 200 Hz to 4000 Hz and a self-winding five foot coiled cable. An LED shall indicate the microphone push-to-talk pushbutton has been pressed and the speaker circuits are ready for transmission.

O. **Remote Microphones:** Enclosed in remote annunciator cabinets with lockable doors. Remote microphones shall duplicate the manual voice transmission capability of the local microphone at the fire alarm control panel. The fire alarm control panel microphone shall have priority over any remote microphones.

2.5 FIRE ALARM WIRING

A. Use (1) pair #18/2 twisted shielded for initiating devices unless directed otherwise by the manufacturer.

B. Use (1) pair #14 for power duct smoke detectors as directed by the manufacturer.

C. Use (1) pair #14 for horn/strobe circuits as directed by the manufacturer.

D. Use (2) pair #18 for control to remote alarm and test station with duct smoke detector.

E. All fire alarm wiring shall be in compliance with NEC Article 760.

F. Magnetic door holder wiring. Furnish addressable relay for each pair of doors. Interwire the door holder to the main fire alarm panel. Complete the associated ceiling smoke detectors wiring to the holders and to the main fire alarm system.

G. Fire alarm supplier to provide circuiting to comply with voltage drop and load calculations per Code requirements.

H. All wire sizes indicated are minimum.

2.6 NAC PANEL

A. Node and NAC panels shall be modular with solid state, microprocessor based electronics, operator interfaces, power supplies, audio generators, amplifiers, battery chargers and batteries as required. All components shall be supervised.

B. Fire alarm vendor/manufacturer shall be responsible for determining the required quantity and location.

2.7 POWER SUPPLIES

A. Fire alarm vendor shall furnish and install power supplies as required for a complete operating system. Electrical Trades shall field select the location as advised by the fire alarm vendor.

2.8 REMOTE ANNUNCIATOR

A. The remote annunciator shall duplicate the backlit LCD display; the alarm acknowledge, supervisory acknowledge, trouble acknowledge, alarm silence, and system reset pushbuttons; the alarm, supervisory, and trouble audible signals; the alarm, supervisory, trouble, and power "on" LED's; and the programmable function keys of the fire alarm control panel. A key "enable" switch or door lock, keyed to match the fire alarm control panel door lock, shall permit activating or deactivating the controls.

B. A remote microphone shall be included with the fire alarm system with emergency voice/alarm communications, along with the same pushbuttons as the fire alarm control panel for selecting pre-recorded voice messages, and the same controls to choose total building or selected areas communications.

2.9 BATTERIES

A. Batteries shall be lead calcium and supervised so that a failure produces a "TROUBLE" signal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install fire alarm wiring in conduit for device shown storage room, mechanical rooms and similar space. Use 5'-0" minimum conduit drop in for physical protection.

B. All junction boxes for fire alarm raceway system shall be painted red labeled "FIRE ALARM". Junction boxes installed in theatrical space where the project requires a black room finish scheme, label the junction box "fire alarm".

C. Provide and install the fire alarm system in strict accordance with the plans and specifications, codes and manufacturer's instructions.

D. Fully test the fire alarm system in accordance with NFPA 72, Chapter 7.

E. Fire alarm vendor shall be responsible to certify the sound coverage for the entire facility.

F. Audio/visual and visual units shall be installed in accordance with Michigan Building Code under the fire protection system section or NFPA 72 Fire Alarm Code wall mounted appliance shall be mounted such that the entire lens is not less than 80 inches, and not greater than 96 inches above the finished floor. Ceiling mounted device is an acceptable method. Ceiling mounting devices are designated with a C subscript letter.

G. Manual pull stations shall be mounted a maximum of 48" from the floor level to the activating handle or to the lever. The current adopted Michigan Building Code edition fire protection system Section 907 shall govern over NFPA 72 Fire Alarm Code for mounting heights.

H. Electrical Trades shall complete the entire fire alarm system in accordance with plans and specifications.

I. Electrical Trades to install the door plate as part of the door holder installation. Mount the plate to hollow metal door. Do not use thru-bolts. The door hardware schedule and the specified architectural installation methods for use by the hardware installer shall govern over the door plate described method.

J. All fire alarm wiring installation that may be required to be installed through non-accessible ceiling spaces, and cannot be installed in conduit or cable tray, free air method will be acceptable for those spaces. Open wiring is acceptable method. Properly secure to ceiling structure, use J hooks or D-rings. The cable shall be plenum rated for this application.

K. Ceiling mounted fire alarm device locations are shown diagrammatic. The design requirement shall be to install the device centered in the classrooms, corridor, offices, etc. Confirm the location with lighting, speaker, HVAC diffusers, to avoid interferences.

L. NAC panel(s) require a dedicated 120 volt power source. The Contractor shall be responsible for coordinating NAC panel quantities and locations with their fire alarm vendor and include all power circuit costs in the bid.

M. Electrical Trades and their respective fire alarm vendor shall field determine the remote duct detector test station location to maintain easy access for the Owner usage. The test station locations are not shown on the drawings.

N. Contractor shall be responsible to wire fire pump controller monitoring points defined as phase loss, phase reversal, power loss and frequency sensitivity. Include fire alarm panel points as part of overall fire alarm panel points.

O. Contractor shall be responsible to wire tamper switch to the fire alarm panel. Include fire alarm panel points as part of the overall fire alarm panel points.

P. Electrical Trades shall complete all fire alarm interface wiring to coiling shutter doors, food service fire suppression system connections, at all sprinkler riser locations. Exterior horn/strobe associated with exterior fire protection fire department hose connections/flow and tamper switches.

Q. Fire alarm vendor shall wire elevator smoke detectors to elevator controller.

R. Electrical Trades shall furnish and install a circuit breaker lock for the 120 volt circuit serving the fire alarm panel. Label the panelboard directory branch circuit text in red.

S. Complete interface wiring from fire alarm panel to egress lighting.

3.2 MANUFACTURER/DISTRIBUTOR SERVICES

A. The following supervision shall be provided by a factory trained service technician from the distributor of the fire alarm equipment.

B. A pre-installation visit to the job site to review equipment submittals and to verify the method by which the system is to be wired.

C. Upon completion of wiring, final checkout and certification of the system shall be made under supervision of this technician.

D. At that time of the formal checkout, technician shall give operational instructions to the Owner.

3.3 WARRANTY

A. Provide a one-year guarantee from date of system acceptance by the Owner.

3.4 CLOSE-OUT

A. Provide O&M manuals, warranty letter, as-built drawings and inspection sign-off.

END OF SECTION

MAI: 2026-01014

SECTION 311000
SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Protecting existing trees and grass to remain.
   2. Removing existing trees, shrubs, groundcovers, plants, and grass.
   3. Clearing and grubbing.
   4. Stripping and stockpiling topsoil.
   5. Removing above and below-grade site improvements, including sidewalks, pavement.
   6. Removal and disconnecting and capping or sealing of site utilities including water, storm, sanitary, gas, electric.
   7. Installation, maintenance and removal of temporary erosion and sedimentation control measures.

1.2 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared and/or removed materials shall become Contractor's property and shall be removed from Project site.

1.3 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service:
   1. Contact local “Miss Dig” by phone at 811 or 800-482-7171 or via the web at either elocate.missdig.org for a single address or rte.missdig.org, a minimum of 72 hours (excluding Saturdays, Sundays and Holidays) in advance of any excavation. Request underground utilities to be located and marked within and surrounding the construction area.
   2. Coordinate with the Owner’s representative for marking privately owned utilities.

D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - EXECUTION

2.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

2.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction, sediment and erosion control measures shown on the Drawings, and a sediment and erosion control plan, specific to the site, that complies with EPA 832/R-92-005 and requirements of the Michigan Department of Management and Budget.

B. Inspect, repair, and maintain erosion and sedimentation control measures daily during construction until permanent vegetation has been established.

C. Once permanent vegetation has been well established, remove erosion and sedimentation controls. Restore and stabilize areas disturbed during removal of temporary erosion and sedimentation control measures.

2.3 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Engineer.

2.4 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
   1. Arrange with utility companies to shut off indicated utilities.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Engineer not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Engineer’s written permission.

C. Removal of underground utilities is included in Division 02 Section Structure Demolition covering site utilities.

2.5 CLEARING AND GRUBBING

A. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

B. Remove trees, shrubs, grass, and other vegetation, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.
   1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.

2.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

2.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove debris, rock, paving and curbs at areas indicated on the drawings for removal. Neatly saw cut edges full depth at a right angle to the surface. Where saw cuts area required in concrete slabs and/or curb and gutter. Saw cut at the nearest joint.

C. Remove all existing pavement structure (including curbs), as shown on the drawings.
   1. Remove pavement to existing edge or joint, where remaining dimension is less than 3 feet.
   2. Provide a butt joint where new pavement meets existing pavement.

2.8 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
   1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.
   2. The contractor shall comply with all applicable Federal, State and Local laws and ordinances regarding transportation and disposal of removed items and waste material. This shall include all M.I.O.S.H.A. regulations.
   3. Continuously clean-up and remove waste materials from the project site. Do not allow waste materials to accumulate on site.

END OF SECTION 311000

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SECTION 312000
EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Excavating and backfilling for utility trenches.
   2. Excavating and backfilling for buildings and structures.
   3. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses, and exterior plantings.
   4. Subbase course for concrete walks.
   5. Subbase and base course for asphalt paving.
   6. Drainage course for slabs-on-grade.

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this section. Other specification sections that directly relate to work of this Section include, but are not limited to:

   1. Section 311000 – Site Clearing
   2. Section 321216 – Asphalt Paving
   3. Section 321313 – Concrete Paving

1.3 REFERENCES

A. MDOT – Michigan Department of Transportation, "Standard Specifications for Construction", latest edition.

B. ASTM - American Society of Testing Materials, latest edition.

C. Local utility standards when working within 24 inches of a utility line.

1.4 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions changes in the Work.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Maximum Density: Maximum dry weight in pounds per cubic foot of a specific material.

I. Optimum Moisture: Percentage of water at maximum density.

J. Rock: All boulders or rock approximately one cubic yard or more and all solid or ledge rock, slate, shale, sandstone and other hard materials that require continuous use of pneumatic tools, heavy rippers or continuous drilling and blasting for removal. Pavements are not included.

K. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

L. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

M. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

N. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

1.6 SUBMITTALS

A. Materials Source: Submit name of imported fill materials suppliers. Aggregate supplier shall provide current test results of materials supplied verifying that supplied products meet product requirements.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from on-site excavations.

B. Subbase Material: Granular material MDOT 902.08, Table 902-3, Class II or IIA.

C. Base Course: For bases to be surfaced with concrete or bituminous mixtures, use Aggregate 21AA unless otherwise specified. MDOT 302.02 and 902.06.

D. Bedding Course: MDOT Class II.

E. Aggregate Surface Course:
   1. Use Aggregate 21AA when the Aggregate surface course is to receive a bituminous surface at a later date. MDOT 306.02 and 902.06.
   2. Use Aggregate 23A when the Aggregate Surface Course is to be constructed without a bituminous surface. MDOT 306.02 and 902.06

PART 3 - EXECUTION

3.1 PREPARATION

A. Contact local “Miss Dig” by phone at 811 or 800-482-7171 or via the web at either elocate.missdig.org for a single address or rte.missdig.org, a minimum of 72 hours (excluding Saturdays, Sundays and Holidays) in advance of any excavation.

B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

C. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."

D. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing" during all earthwork operations.

3.2 EXCAVATION

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
   1. Clearance: As indicated on Detail Sheet.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.7 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.8 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."

D. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

E. Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.9 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill.
   5. Under footings and foundations, use engineered fill.

3.10 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.11 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698 or ASTM D 1557:
   1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
   2. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.

3. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.12 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus or minus 1 inch.
   2. Walks: Plus or minus 1 inch.
   3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.13 SUBBASE AND BASE COURSES

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements and walks as follows:

   1. Shape subbase and base course to required crown elevations and cross-slope grades.
   2. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698 or ASTM D 1557.

3.14 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
   1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.15 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified MDOT certified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing

subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Engineer.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable and provide copies of the test reports to the engineer.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.16 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 312000

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SECTION 321216
ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Placement of bituminous pavements including paving and surfacing for roads, driveways, parking lots, walkways, paths and shoulders.

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this section. Other specification sections that directly relate to work of this Section include, but are not limited to:
   1. Section 312000 – Earth Moving

1.3 Definitions:
   1. Asphalt Base course: The layer of asphalt of designed thickness placed on the aggregate base to support leveling and surface courses, a mix layer below 4 inches from the finished surface.
   2. Asphalt Leveling course: Layer of specified material placed on the asphalt base course in preparation for the surface course, a mix layer within 4 inches of the surface.
   3. Asphalt Surface course: The top layer of a pavement structure, a mix layer within 4 inches of the surface.
   4. Maximum density (bituminous mixtures): Maximum unit weight of a representative sample of the hot mix asphalt according to the Marshall Method ASTM D2726.
   5. Maximum density (soils): Maximum unit weight of soil material according to Modified Proctor Method ASTM D1557.
   6. Pavement structure: Any combination of subbase, base and asphalt courses, including shoulders, placed on subgrade.
   7. Subbase: The layer of specified material of designed thickness placed on the subgrade as a part of the pavement structure.
   8. Subgrade: That portion of the earth grade upon which the pavement structure is to be placed.

1.4 REFERENCES:

A. A. MDOT – Michigan Department of Transportation, "Standard Specifications for Construction", latest edition.

B. ASTM - American Society of Testing Materials, latest edition.

1.5 SUBMITTALS:

A. Asphalt and Concrete Mix Designs: Provide job-mix formula prepared by independent AASHTO Accredited lab or approved by MDOT for bituminous base, leveling and surface courses to the Engineer a minimum of two weeks prior to paving.

B. Certification of quality by producer for the following:
   1. Aggregates
   2. Asphalt cement
   3. Pavement marking material
   4. Prime coat
   5. Bond coat

1.6 JOB CONDITIONS:

A. Seasonal Limitations: Unless otherwise approved by the Engineer in writing, place HMA in accordance with subsection 501.03.I.1 of the MDOT Spec Book and the following seasonal limitations:
   1. From June 1 to October 15 for the Upper Peninsula;
   2. From May 15 to November 1 for the Lower Peninsula, north of M-46; and
   3. From May 5 to November 15 for the Lower Peninsula, south of M-46.

B. Clean up promptly following pavement installation.

C. Maintenance of Temporary Surfaces: Maintain temporary surfaces until permanent pavement installation is completed.

D. Driveway Closing: Twenty-four (24) hour maximum.

E. Allow access to the bituminous plant for verification of mix proportions, aggregate gradations and temperatures.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Aggregate Shoulders and Approaches:
   1. Use Aggregate 22A for construction of Class AA shoulders and approaches. MDOT 307.02 and 902.06.
   2. Use Aggregate 23A for construction of Class A shoulders and approaches. MDOT 307.02 and 902.06.
   3. Use roadway excavation or borrow material for construction of Class B shoulders and approaches. MDOT 307.02 and 902.06.

B. Hot Mix Asphalt (HMA) Base Course (if required):
   1. MDOT 501.03, HMA 4EL.
   2. MDOT 902.06, Dense-Graded Aggregate.
   3. MDOT 904.03, Asphalt binder, PG 58-28.

C. Hot Mix Asphalt (HMA) Leveling Course:
   1. MDOT 501.03, HMA 4EL.
   2. MDOT 902.06, Dense-Graded Aggregate.
   3. MDOT 904.03, Asphalt binder, PG 58-28.

D. Hot Mix Asphalt (HMA) Top Course:
   1. MDOT 501.03, HMA 5EL.
   2. MDOT 902.06, Dense-Graded Aggregate.
   3. MDOT 904.03, Asphalt binder, PG 58-28.

E. Hot Mix Asphalt (HMA) Hand Patching:
   1. MDOT 501.02, HMA, 4EL.
   2. MDOT 902.05, Dense-Graded Aggregate.
   3. MDOT 904.03, Asphalt binder, PG58-28.

F. Bond Coat: Asphalt material Asphalt material SS-1h or CSS-1h, when bond coat is required. MDOT 501.02 and 904.03C.

G. Pavement Marking: Conform to MDOT 811.02.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

B. Examine areas and conditions, with paver present, for compliance with requirements for correct and level finished grade and other conditions affecting performance. Notify the contractor of conditions detrimental to the proper and timely installation and completion of the work.

C. Do not proceed with the work until unsatisfactory conditions have been corrected by the contractor in a manner acceptable and to the satisfaction of the Engineer or Owner's Representative.

D. Beginning of installation means acceptance of existing conditions.

3.2 PLACEMENT

A. Shoulder Area (aggregate): Provide compacted aggregate shoulder on an aggregate base to the thickness noted in the plans.

B. Shoulder Area (other than aggregate): Stabilize shoulder to a 4 inch depth with compacted soil or topsoil.

C. Bituminous Base Course:
   1. Construction Methods: Conform placement of the bituminous base course mixture in accordance with MDOT 501.03.F through 501.03.J.
   2. Tolerances:
      a. Curbed streets: Shape the bituminous base course to the established grade and cross section, within a tolerance of 3/8 inch.
      b. Other: Unless otherwise specified, shape within 3/4 inch of the established grade and cross section.

D. Bituminous Bond Coat:
   1. Construction Method: Apply between successive paving courses and along longitudinal joint between successive lanes/pulls.
   2. Application Rate: Provide 0.05-0.15 gallon per square yard. (Adequate even coverage).

E. Bituminous Leveling and Surface Courses:
   1. Cutting: Saw vertically and in straight lines at any angle with pavement centerline.

2. Thickness: Do not place bituminous surface course mixture in lifts exceeding 2 inches unless otherwise approved. Provide design thickness.
3. Construction Methods:
   a. Paving: Conform method of paving to MDOT 501.03.F through 501.03.J.
   b. Prior to placement of bituminous surface, verify crowns and grades of roadway for positive drainage. Any deficiencies in grade or crown shall be corrected prior to placement of surface course.
4. Tolerances: Bituminous surface on streets with new curbs shall have a finish elevation of ¼ inch above curb.
5. Pavement Density: Minimum ninety-two percent (92%) of theoretical maximum density.

3.3 TESTING AND INSPECTION:

A. Observation: By the Owners Representative.

B. Acceptance Testing: Contractor shall employ a qualified testing agency. Contractor shall coordinate for access to test materials as required.
1. If initial testing indicates failed or nonconformance to specification, perform additional test. If further testing verifies nonconformance, additional testing shall be paid by CONTRACTOR. Replace nonconforming material at no additional cost to OWNER.
2. Contractor shall provide all test reports to owner within 24 hours of test.

C. Aggregates:
1. Sampling and Analysis: Michigan Testing Methods, Series 100.
2. Exception: Provide certification of approved stockpiled material.

D. Bituminous Mix Composition:
1. Sampling: ASTM D979, one sample per mix or one per two thousand tons.
2. Extraction: ASTM D2172.
3. Sieve Analysis: ASTM C117 and ASTM C136.

E. Testing agency will test compaction of bituminous concrete in place according to ASTM D2950 and provide copies of the test reports to the engineer.

END OF SECTION 321216

SECTION 321313
CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes exterior cast-in-place concrete materials for the following:
   1. Sidewalks.
   2. Concrete Pads.

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this section. Other specification sections that directly relate to work of this Section include, but are not limited to:
   1. Section 033000 – Cast in Place Concrete
   2. Section 312000 – Earth Moving
   3. Section 321374 – Concrete Paving Joint Sealants

1.3 REFERENCES:

A. MDOT – Michigan Department of Transportation, "Standard Specifications for Construction", latest edition.

B. ASTM - American Society of Testing Materials, latest edition.

1.4 SUBMITTALS

A. Concrete Mix Designs: Provide job-mix formula prepared by independent AASHTO Accredited lab or approved by MDOT

B. Concrete Test Specimens: Deliver to the place of inspection and testing.

C. Certification of quality by producer for the following:
   1. Cementitious materials
   2. Admixtures
   3. Aggregates

D. Curing Compound Concrete Test Results: For each specimen.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Plain-Steel Welded Wire Reinforcement: Conform to MDOT 905.06.

B. Concrete sidewalks and slabs: Unless otherwise specified use concrete Grade 3500. Conform to MDOT 803.02, 701.02, 6 sacks per cubic yard minimum.

C. Concrete Joint Filler: Conform to MDOT 914.03 and 914.04 A.

2.2 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, with the following properties.
1. Compressive Strength (28 Days): 3500 psi.
2. Slump Limit: 4 inches plus or minus 1 inch.
3. Air Content: 6 percent plus or minus 1.5 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

B. Examine areas and conditions, with paver present, for compliance with requirements for correct and level finished grade and other conditions affecting performance. Notify the contractor of conditions detrimental to the proper and timely installation and completion of the work.

C. Do not proceed with the work until unsatisfactory conditions have been corrected by the contractor in a manner acceptable and to the satisfaction of the Engineer or Owner's Representative.

D. Beginning of installation means acceptance of existing conditions.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.4 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness to match jointing of existing adjacent concrete pavement.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.

B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

D. Screed pavement surfaces with a straightedge and strike off.

E. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.6 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
   2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
   3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on pavement surface according to manufacturer's written instructions.
   1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
   2. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

3.7 CONCRETE PROTECTION AND CURING

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

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing compound or a combination of these methods.

3.8 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:
   1. Elevation: 1/4 inch.
   2. Thickness: Plus 3/8 inch, minus 1/4 inch.
   3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
   4. Joint Spacing: 3 inches.
   5. Contraction Joint Depth: Plus 1/4 inch, no minus.
   6. Joint Width: Plus 1/8 inch, no minus.

3.9 TESTING AND INSPECTION:

A. Observation: By Owner’s designated authorized representative.
   1. Inspection of forms by Owner’s representative is required prior to pouring concrete.

B. Acceptance Testing:
   1. Contractor shall employ a certified American Concrete Institute/Michigan Concrete Association Concrete Field Testing Technician.
   2. Concrete:
      a. Sample: ASTM C172
      b. Frequency: Once for each 50 cubic yards, or less, of each class of concrete placed each day.
      c. One additional test cylinder will be taken during cold weather and be cured on site under the same conditions as the concrete it represents.
      d. One slump test will be taken for each set of test cylinders made.
      e. Perform following from sample:
         1) Mold three 6-inch cylinder compressive strength specimens: ASTM C31.

2) Slump test: ASTM C143.
3) Air test: ASTM C231.
4) Yield test: ASTM C138.
5) Strength test: ASTM C139.

3. If initial testing indicates nonconformance to specifications, additional testing shall be paid by Contractor. Replace nonconforming material at no additional cost.

3.10 PAVEMENT MARKING

A. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.

B. Sweep and clean surface to eliminate loose material and dust.

C. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement.

C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

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SECTION 321374
CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Expansion and contraction joints within cement concrete pavement.
   2. Joints between cement concrete and asphalt pavement.

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this section. Other specification sections that directly relate to work of this Section include, but are not limited to:
   1. Section 321313 – Concrete Paving

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each type and color of joint sealant required.

C. Compatibility and Adhesion Test Reports: From sealant manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: MDOT approved.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Conform with MDOT Section 914.

2.3 INSTALLATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience.

C. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

D. Install backer materials to support sealants during application and at position required to produce optimum sealant movement capability. Do not leave gaps between ends of backer materials. Do not stretch, twist, puncture, or tear backer materials. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

E. Install sealants at the same time backings are installed to completely fill recesses provided for each joint configuration and to produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

G. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION 321374

SECTION 329200
TURF RESTORATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the work required for the restoration of areas disturbed by construction including:
   1. Topsoil,
   2. Seeding,
   3. Mulch,
   4. Fertilizer,
   5. Hydroseeding,

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this section. Other specification sections that directly relate to work of this Section include, but are not limited to:
   1. Section 312000 – Earth Moving

1.3 REFERENCES

A. MDOT – Michigan Department of Transportation, "Standard Specifications for Construction", latest edition.

1.4 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

E. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poi-son Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass

1.5 SUBMITTALS

A. Topsoil
   1. Analysis: Certification of suitability by local agricultural agent.

B. Grass Seed:
   1. From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

C. Mulch
   1. Source and Content: Certification by supplier.

D. Fertilizer
   1. Analysis: Certification of suitability by local agricultural agent.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
   1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
   2. Pesticide Applicator: State licensed, commercial.
   3. Seeding, Mulching, Sodding and Weed Control shall comply with Michigan Department of Transportation (MDOT) Specification for Construction, most recent edition.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials:
   1. Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Bulk Materials:
   1. Do not dump or store bulk materials near structures, utilities, or on existing turf areas or plants. Storage on walkways and pavements shall be coordinated with the owner.
   2. Provide erosion-control measures, as required, to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, and/or walkways.
   3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 JOB REQUIREMENTS

A. Areas Disturbed by Construction
   1. Restoration of lawn areas: Fine grade to 6 inches below finish elevations. Remove all stones and debris greater than ½" diameter. Place topsoil, seed, fertilizer, mulch and mulch anchoring as show on the detail sheet.

B. Scheduling:
   1. Restoration of lawns and other surface features: Promptly following curb and gutter, site improvements and paving.

2. Clean up: Ongoing and promptly following turf restoration.

C. Seasonal Limitations: MDOT 816.03.C.4.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: MDOT 815.03.A and 816.03
1. Topsoil shall be screened.

B. Chemical Fertilizer:
1. Furnish and apply fertilizer(s) as needed. It is the Contractor's responsibility to perform soil tests, as required, to select the fertilizer type(s) and the rate at which it is applied for all listed applications. Phosphorus is allowed for use only at the time of planting and when required by soil conditions.

C. Grass Seed: MDOT 816.03.C
1. High Traffic Lawns: Twenty Five percent (25%) Perennial Ryegrass, Fifteen percent (15%) Kentucky Bluegrass, Forty percent (40%) Creeping Red Fescue, (20%) Tall Fescue.
2. Other areas: Ten percent (10%) Perennial Ryegrass, Thirty Five percent (35%) Atlantis Kentucky Bluegrass, Twenty Five percent (25%) Park Kentucky Bluegrass, Fifteen percent (15%) Creeping Red Fescue, Ten percent (10%) Annual Ryegrass, Five percent (5%) Chewings Fescue.
3. Athletic Fields: Seed blend shall consist of a minimum of 3 bluegrass varieties and one of the ryegrass varieties. Blend shall be 95% Kentucky Bluegrass and 5% Perennial Ryegrass by weight. Only Elite bluegrasses (according to NTEP characteristics ratings) will be allowed on Athletic surfaces. No "named common" types will be accepted. Enhanced Elite varieties will be allowed at same seeding rates.

D. Mulch
1. Mulch Blanket: Excelsior or straw mulch blanket listed on the current Qualified Products List, MDOT Materials Sampling Guide. Straw mulch if specified in plans.
a. All slopes equal to or steeper than 1 ft vertical per 4 ft horizontal shall have an excelsior mulch blanket rated for the slope(s) indicated on the plans, installed per manufacturer's recommendations.
2. Mulch Anchoring: Qualified Products List, MDOT Materials Sampling Guide.

E. Pesticides
1. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides.
2. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
3. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
      a. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.
   2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

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

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
   2. Protect grade stakes set by others until directed to remove them.

B. Verify trench backfilling have been inspected.

3.3 TOPSOIL

A. Construction methods: MDOT 816.03.

B. Verify Engineer has approved topsoil material prior to starting work.

C. Place topsoil in preparation of seeding or sodding at the specified thickness.

D. Place topsoil in dry weather.

3.4 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to MDOT Specifications.

B. Fine grade soil surface to eliminate uneven areas, ruts and low spots. Remove weeds, debris, roots, branches, stones in excess of ½" in size.

C. Loosen soil to a depth of four inches (4") in lawn areas by approved method of scarification and grade to remove ridges and depressions. Remove all stones or foreign matter from top two inches (2") of soil

D. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.

1. Reduce elevation of planting soil to allow for soil thickness of sod.

E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Before planting, obtain Engineer's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.5 SEEDING

A. Do not sow immediately following rain, when the ground is too dry, or during windy periods. No seeding shall occur on frozen ground or at temperatures lower than 32° F (0° C).

B. All seeding is to be done in dry or moderately dry soil and at times when the wind does not exceed a velocity of five (5) miles per hour.

C. Immediately before sowing the seed, the earth surface shall be re-worked until it is a fine, pulverized, smooth seedbed, showing not more than 1/4" variance from grade.

D. Apply seed mixture, as specified at a rate of 2.5-4 lbs/100 sq. ft. Apply seed by drilling in two directions, at a rate of 1.25-2 lbs. /1000 sq. ft. in each direction. Seed shall be uniformly spread over the previously fine graded and fertilized topsoil. Hand sew seeds around irrigation system heads and other obstructions.

E. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
2. Do not use wet seed or seed that is moldy or otherwise damaged.
3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

F. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

G. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

H. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.

I. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
2. Bond straw mulch by spraying mulch anchoring from the MDOT Qualified Products list. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

J. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch and roll surface smooth.

3.6 MULCHING

A. Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150mm) long.

B. Contractor shall return to site six (6) weeks after installation to remove mesh.

3.7 FERTILIZER

A. Construction methods: MDOT 816.03B. Application rate: 150 lbs/acre.

3.8 HYDROSEEDING

A. Hydroseeding shall comply with MDOT Specifications.

3.9 TURF MAINTENANCE

A. If an area washes out after this work has been properly completed and approved by the owners representative, make the required corrections to prevent future washouts and re-place the topsoil, fertilizer, seed and mulch. This replacement will be paid for as additional work using the applicable contract items. If an area washes out for reasons attributable to the Contractor's activity or failure to take proper precautions, replacement will be at the Contractor's expense

B. General:
1. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
2. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
3. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
4. Apply treatments as required to keep turf and soil free of pests, weeds and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

C. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches, if required by the Engineer.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

D. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.
1. Seeded lawns shall never reach a height of three (3) inches prior to a cutting and shall be cut to a height of two (2) inches. The contractor is responsible for setting up a watering

schedule and adjusting accordingly as environment conditions change throughout the growing season.

2. If, for reasons beyond the Sub-contractor's control, the height of the grass has exceeded three (3) inches, the mower blades shall be raised so that at no time will more than 1/3 of the grass leaf surface be removed.

E. Contractor shall provide additional fertilizer applications as necessary, to stimulate rapid turfgrass growth

F. Contractor shall notify the Owner through the Engineering in writing one (1) week in advance of the final lawn cutting to allow the Owner and the Engineer to inspect the lawns and schedule the contractors maintenance work. The Owner will accept the lawns after a minimum of three (3) cuttings if a uniform cover of grass is established and is acceptable to Owner and Engineer.

G. If an infestation of weeds or crab grass develops prior to acceptance of the lawn, the Contractor shall immediately treat the infestation by hand weeding or chemical control. The chemical control shall be furnished and installed by the contractor as recommended by the manufacturer and approved by the Engineer. At least two weeks shall elapse after chemical control is applied before a request or inspection for acceptance is made to the Engineer

3.10 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Engineer:

1. Satisfactory Seeded Turf:
   a. At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.11 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with City’s operations and others in proximity to the Work. Notify the Engineer before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.12 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 329200

SECTION 333100
SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Pipe and fittings.
   2. Nonpressure and pressure couplings.
   3. Expansion joints and deflection fittings.
   4. Cleanouts.
   5. Encasement for piping.
   6. Manholes.

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this section. Other specification sections that directly relate to work of this Section include, but are not limited to:
   1. Section 033000 – Cast In-Place Concrete.
   2. Section 312000 – Earth Moving.

1.3 SUBMITTALS

A. Product Data for the following:
   1. Pipe and fittings.
   2. Non-pressure and pressure couplings
   3. Cleanouts.

B. Shop Drawings:
   1. For manholes. Include plans, elevations, sections, details, and frames and covers.

1.4 QUALITY ASSURANCE

A. Comply with standards requirements of authorities having jurisdiction.

B. Comply with the Recommended Standards for Wastewater Facilities (Ten States Standard) Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers.

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

1.6 FIELD CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Owner no fewer than two days in advance of proposed interruption of service.
   2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 ABS PIPE AND FITTINGS

A. ABS Sewer Pipe and Fittings: ASTM D 2751, with bell-and-spigot ends for gasketed joints.
   1. NPS 3 to NPS 6: SDR 35.
   2. NPS 8 to NPS 12: SDR 42.

B. Gaskets: ASTM F 477, elastomeric seals.

2.2 PVC PIPE AND FITTINGS

A. PVC Type PSM Sewer Piping:
   1. Pipe: ASTM D 3034, SDR 26, PVC Type PSM sewer pipe with bell-and-spigot end for gasketed joints.
   2. Fittings: ASTM D 3034, PVC with bell ends.
   3. Gaskets: ASTM F 477, elastomeric seals.

B. PVC Gravity Sewer Piping (NPS 18 to NPS 36):
   1. Pipe and Fittings: ASTM F 679, T-1 wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

C. PVC Pressure Piping:
   1. Pipe: AWWA C900, Class 200 PVC pipe with bell-and-spigot ends for gasketed joints.
   2. Fittings: AWWA C900, Class 200 PVC pipe with bell ends.
   3. Gaskets: ASTM F 477, elastomeric seals.

2.3 HDPE PIPE AND FITTINGS

A. High density polyethylene pipe conforming to ASTM D1598 and D3350, AWWA C906 and ANSI/NSF-14 and 61, material shall be comprised of PE 3408 Resin with a cell classification of PE334434C.
   1. Pipe shall have a wall thickness of DR-11 and a working pressure rating of 160 psi.
   2. Materials and workmanship shall be as required by AWWA M55, PE Pipe Design and Installation Manual and ASTM F714 Manufacturing requirements.
   3. HDPE pipe, appurtenances, and installation methods shall conform to the latest addition of AWWA C906. The AWWA Standard Code C906 identification must appear on the exterior wall print line of the HDPE pipe proposed for potable use and installation. All DDPE materials must be listed and approved for use with potable water under ANSI/NSF Standard 14. ANSI/NSF Standard 14 meets the requirements of ANSI/NSD Standard 61.

The exterior wall print lines of all HDPE pipe proposed for installation and potable use must bear the NSF-pw identification.

4. Pipe shall be furnished in Ductile Iron pipe sizes.
5. Pipe shall be handled and installed in accordance with manufacturer's recommendations.
6. Pipe shall be furnished with continuous, permanent print line identifying pipe size, pressure rating, trade name, material classification, ASTM and NSF standards, pipe test category, plant location and shift, date of manufacture, operator and extruder numbers, and supplier of raw materials.
7. Exterior wall print line must bear NSF – PW identification.
8. No installations shall exceed ten feet (10') of cover unless approved by the Engineer or as directed by the plans and specifications. The City Engineer must approve the use of HDPE pipe in any water main project within the City.

B. Fittings and Couplings; Fittings and specials shall be of the same construction and design as the pipe. The manufacturer of the pipe shall be the same as the manufacturer of the fittings and other fabrications.

C. Joints; Joints shall be thermally butt-fused according to the recommendations of the manufacturer.

D. HDPE Restraint Methods;
1. Restrained joints include butt fusions, electro-fusions, socket fusions, bolted flange connections, MJ Adapter connections or other restrained mechanical connections.
2. Provide joint restraints on long string of butt fused HDPE to bell and spigot or mechanical sleeve joint.
    a. Wall Anchor;
        1) Restrain the transition connection by butt fusing a Wall Anchor in the HDPE pipeline close to the connection and pouring a concrete anchor around it as shown in Details. Refer to the pipe manufacturer’s recommendations on anchor size and pull out loads.
    b. Mechanical Joint.
        1) Restrain the transition connection and several non-PE bell and spigot joints down line from the transition connection.
        2) Distance of pipe restraint needs to be identified on the drawings and noted in the HDPE to DIP Connection Detail. At minimum the Contractor shall provide pipe restraint per the requirements of a “Dead End” pipe as noted in the “Pipe Restraint Schedule” or 3 Pipe Lengths, whichever is greater

E. HDPE Pipe Connection to PVC Bell End;
1. Flex restraint pieces are electro-fused to the HDPE pipe to achieve the proper stab depth in the PVC bell and the restraint harness plate is attached behind them. The opposite end of the restraint harness is attached behind the PVC hub.
2. Install the HDPE pipe in the PVC bell until it bottoms out on the flex restraints and tighten the tie rods to prevent the assembly from pulling apart.
3. A stiffener is to be installed in the HDPE pipe end.
4. Contractor is to follow manufacturer’s recommended procedures for this assembly.

F. Mechanical Connection – HPDE to PVC;
1. Provide coupling on plain-end PVC pipe to plain-end HDPE pipe without special adapters.
2. When connecting HDPE pipe to a mechanical coupling, the fitting unless otherwise stated by the coupling manufacturer.

2.4 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
   1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Ring-Type, Flexible Couplings:
   1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring

2.5 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile-Iron, Flexible Expansion Joints:
   1. Joints for Ductile Iron Pipe to be Tyton, Bell Tite, Fast Tite or equal.
   2. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed balljoint sections and one or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.

B. CLEANOUTS
   1. PVC Cleanouts:
      a. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
      b. Cleanout to be constructed as noted in the Details.
      c. PVC to meet ASTM D-3034.
      d. Cleanout lid per plans.

2.6 MANHOLES

A. Standard Precast Concrete Manholes:
   1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
   2. Diameter: 48 inches minimum unless otherwise indicated.
   3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
   4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
   5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
   6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
   7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
   8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
   9. Steps: Co-polymer polypropylene and plastic, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals.
   10. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole

frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.

11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:
   1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser, with 4-inch- minimum-width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
   2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.7 CONCRETE

A. General: Cast-in-place concrete in accordance with ACI 318, ACI 350, and the following:
   1. Cement: ASTM C 150/C 150M, Type II.
   2. Fine Aggregate: ASTM C 33/C 33M, sand.
   3. Coarse Aggregate: ASTM C 33/C 33M, crushed gravel.
   4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
   1. Reinforcing Fabric: ASTM A 1064/A 1064M, steel, welded wire fabric, plain.
   2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
   1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
      a. Invert Slope: 1 percent through manhole.
   2. Benches: Concrete, sloped to drain into channel.
      a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
   1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
   2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary drainage piping. Location and arrangement of piping

layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow, nonpressure drainage piping in accordance with the following:
   1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
   2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
   3. Install piping with 66 inch minimum cover.
   4. Install ductile-iron, gravity sewer piping according to ASTM A 746.
   5. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
   6. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
   7. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.

F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:
   1. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
   2. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
   3. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
   4. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
   5. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
   1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
      a. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Form continuous concrete channels and benches between inlets and outlet.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete in accordance with ACI 318.

3.6 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

B. Set cleanout frames and covers in pavement and sidewalk areas with tops flush with pavement surface.

3.7 CONNECTIONS

A. Make connections to existing piping and underground manholes.
   1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
   2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
   3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
      a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
      b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
   4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
   1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
      a. Shielded flexible couplings for same or minor difference OD pipes.

b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.8 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.9 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Re-inspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems in accordance with requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.

C. Manholes: Perform hydraulic test according to ASTM C 969.

D. Leaks and loss in test pressure constitute defects that must be repaired.

E. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.10 CLEANING

A. A. Clean dirt and superfluous material from interior of piping.

END OF SECTION 333100

SECTION 334200
STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:
1. Pipe and fittings.
2. Nonpressure transition couplings.
3. Pressure pipe couplings.
4. Expansion joints and deflection fittings.
5. Backwater valves.
6. Cleanouts.
7. Drains.
8. Encasement for piping.
9. Manholes.
10. Channel drainage systems.
11. Catch basins.
12. Storm water inlets.
13. Storm water detention structures.
14. Pipe outlets.
15. Dry wells.
16. Storm water disposal systems.

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this section. Other specification sections that directly relate to work of this Section include, but are not limited to:
1. Section 033000 – Cast In-Place Concrete.
2. Section 312000 – Earth Moving.

1.3 REFEENCES

A. This section references American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), and American Water Works Association (AWWA), UNI-Bell PVC Pipe Association (UNI), which are made part hereof by such references, and shall be the latest edition and revision thereof. All material, manufacturing, operations, testing, inspection and production of Poly (Vinyl Chloride) (PVC) sewer pipe shall conform to the following referenced standards:
1. ASTM C33 Standard Specification for Concrete Aggregates
2. ASTM D448 Standard Classification for Sizes of Aggregate for Road & Bridge Construction.
3. ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
4. ASTM F679 Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
5. ASTM F789 Standard Specification for Type PS-46 and Type PS-115 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings.

6. ASTM F794 Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
7. ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
8. UNI-B-6 Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:
1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins, storm water inlets and dry wells. Include plans, elevations, sections, details, frames, covers, and grates.
3. Storm water Detention Structures: Include plans, elevations, sections, details, frames, covers.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes in accordance with manufacturer's written rigging instructions.

D. Handle catch basins and storm water inlets in accordance with manufacturer's written rigging instructions.

1.6 FIELD CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

A. Corrugated-Steel Pipe and Fittings: ASTM A 760/A 760M, Type I with fittings of similar form and construction as pipe.
1. Special-Joint Bands: Corrugated steel with O-ring seals.
2. Standard-Joint Bands: Corrugated steel.
3. Coating: Aluminum.

2.2 PVC TRUSS PIPE AND FITTINGS

A. PVC Truss Pipe and Fittings: ASTM D 2680-01, with bell-and-spigot ends for gasketed joints.

1. NPS 3 to NPS 6: SDR 35.
2. NPS 8 to NPS 12: SDR 42.

B. Gaskets: ASTM F 477, elastomeric seals.

2.3 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10 : AASHTO M 252M, Type S, with smooth waterway for coupling joints.
1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
2. Soiltight Couplings: AASHTO M 252M, corrugated, matching tube and fittings.

B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60; AASHTO M 294M, Type S, with smooth waterway for coupling joints.
1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
2. Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

2.4 PVC PIPE AND FITTINGS

A. PVC Cellular-Core Piping:
1. PVC Cellular-Core Pipe and Fittings: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
2. Fittings: ASTM D 3034, SDR 35 or SDR 26, PVC socket-type fittings.

B. PVC Corrugated Sewer Piping:
1. Pipe: ASTM F 949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F 477, elastomeric seals.

C. PVC Profile Sewer Piping:
1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

D. PVC Type PSM Sewer Piping:
1. Pipe: ASTM D 3034, SDR 35 or SDR 26, PVC Type PSM sewer pipe with bell-and spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

E. PVC Gravity Sewer Piping:
1. Pipe and Fittings: ASTM F 679, T-1 wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.
2. Pipe: AWWA C900, Class 200 PVC pipe with bell-and-spigot ends for gasketed joints.
3. Fittings: AWWA C900, Class 200 PVC pipe with bell ends
4. Gaskets: ASTM F 477, elastomeric seals.

2.5 CONCRETE PIPE AND FITTINGS

A. A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76.
1. Bell-and-spigot or tongue-and-groove ends and gasketed joints with ASTM C 443, rubber gaskets.
2. Class III, Wall B or C.
3. Class IV, Wall B or C.
4. Class V, Wall B or C.
5. Wall B may be used for all pipe sizes less than 24-inch, where depth is less than 16 feet.
6. Wall C shall be used for pipe sizes 24-inch and larger at any depth and for all pipe size where depth is 16 to 25-feet.
7. The minimum strength class (D-Load) for the pipe shall be in accordance with the following table.

REINFORCED CONCRETE PIPE Class vs. Depth to Invert			
Pipe Size	Class III	Class IV	Class V
12”	1-15	15-24	24-35
15”	1-15	15-24	24-35
18”	1-15	15-24	24-35
21”	1-15	15-24	24-35
24”	1-15	15-24	24-35
27”	1-15	15-24	24-35
30”	1-15	15-24	24-35
33”	1-15	15-24	24-35
36”	1-15	15-24	24-35
42”	1-15	15-24	24-35
48”	1-15	15-24	24-35

8. The minimum pipe class required when the pipe is 6-feet or less shall be Class IV.

2.6 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
1. For Concrete Pipes: ASTM C 443 rubber.
2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Ring-Type, Flexible Couplings:
1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.7 CLEANOUTS

A. Plastic Cleanouts:
1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.8 MANHOLES

A. Standard Precast Concrete Manholes:
   1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
   2. Diameter: 48 inches minimum unless otherwise indicated.
   3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
   4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
   5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
   6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
   7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
   8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
   9. Steps: Individual FRP steps or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP. wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches. Steps to be a minimum 10-inch wide.
   10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope. Adjustment rings shall be 2-inch, 3-inch or 4-inch thickness.

B. Manhole Frames and Covers:
   1. Description: Size and type to be called out on the drawings. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
   2. Material: ASTM A 536, Grade 60-40-18 ductile or ASTM A 48/A 48M, Class 35 gray iron unless otherwise indicated.

2.9 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:
   1. Cement: ASTM C 150, Type II.
   2. Fine Aggregate: ASTM C 33, sand.
   3. Coarse Aggregate: ASTM C 33, crushed gravel.
   4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
   1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
   2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
   1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
      a. Invert Slope: 1 percent through manhole.
   2. Benches: Concrete, sloped to drain into channel.
      a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
   1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
   2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.10 2.14 CATCH BASINS

A. Standard Precast Concrete Catch Basins:
   1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
   2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
   3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
   4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
   5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
   6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
   7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate. Adjustment rings shall be 2- inch, 3-inch or 4-inch thickness.
   8. Steps: Individual FRP steps or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step, min 10-inches. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
   9. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: Size and type to be called out on the drawings.

2.11 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to the Standard Details.
   1. Frames and Grates: Heavy duty, according to the Standard Details.

2.12 STORMWATER DETENTION STRUCTURES

A. Cast-in-Place Concrete, Storm water Detention Structures: Constructed of reinforced concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
   1. Ballast: Increase thickness of concrete as required to prevent flotation.
   2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.
   3. Steps: Individual FRP steps or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of structure to finished grade is less than 60 inches.

B. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2.13 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregularly sized and shaped, graded stone according to MDOT Standards for Slope Protection

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow, nonpressure drainage piping in accordance with the following:
1. Install piping pitched down in direction of flow.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with 36-inch- minimum cover.
4. Install corrugated-steel piping in accordance with ASTM A 798/A 798M.
5. Install corrugated-aluminum piping in accordance with ASTM B 788/B 788M.
6. Install PE corrugated sewer piping in accordance with ASTM D 2321.
7. Install PVC cellular-core piping in accordance with ASTM D 2321 and ASTM F 1668.
8. Install PVC sewer piping in accordance with ASTM D 2321 and ASTM F 1668.
9. Install PVC profile gravity sewer piping in accordance with ASTM D 2321 and ASTM F 1668.
10. Install PVC water-service piping in accordance with ASTM D 2321 and ASTM F 1668.

11. Install reinforced-concrete sewer piping in accordance with ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping in accordance with the following:
   1. Join corrugated-steel sewer piping in accordance with ASTM A 798/A 798M.
   2. Join corrugated-aluminum sewer piping in accordance with ASTM B 788/B 788M.
   3. Join corrugated-PE piping in accordance with ASTM D 3212 for push-on joints.
   4. Join PVC cellular-core piping in accordance with ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
   5. Join PVC corrugated sewer piping in accordance with ASTM D 2321 for elastomeric-seal joints.
   6. Join PVC sewer piping in accordance with ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
   7. Join PVC profile gravity sewer piping in accordance with ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
   8. Join reinforced-concrete sewer piping in accordance with ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
   9. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

B. Set cleanout frames and covers in pavement and sidewalk areas with tops flush with pavement surface.

3.5 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants in accordance with ASTM C 891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.6 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.7 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

3.8 CONCRETE PLACEMENT

A. Place cast-in-place concrete in accordance with ACI 318.

3.9 CHANNEL DRAINAGE SYSTEM INSTALLATION

A. Install with top surfaces of components, except piping, flush with finished surface.

B. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

C. Embed channel sections and drainage specialties in 4-inch minimum concrete around bottom and sides.

D. Fasten grates to channel sections if indicated.

E. Assemble channel sections with flanged or interlocking joints.

F. Embed channel sections in 4-inch minimum concrete around bottom and sides

3.10 CONNECTIONS

A. Make connections to existing piping and underground manholes.
   1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
   2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
   3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
      a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
   a. Shielded flexible couplings for same or minor difference OD pipes.
   b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.11 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.12 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems in accordance with requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test in accordance with requirements of authorities having jurisdiction, UNI-B-6, and the following:
6. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
7. Option: Test plastic piping in accordance with ASTM F 1417.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.13 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION 334200

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