MOORE PUBLIC SCHOOLS
NEW ASC BOARDROOM / STORM SHELTER BUILDING

INDEPENDENT DISTRICT NO. 2
CLEVELAND COUNTY, MOORE, OKLAHOMA

1500 SOUTHEAST 4TH STREET
MOORE, OKLAHOMA 73160

PROJECT MANUAL

JULY 2026

AGP | the Abla Griffin Partnership

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ARCHITECT:

AGP | the Abla Griffin Partnership

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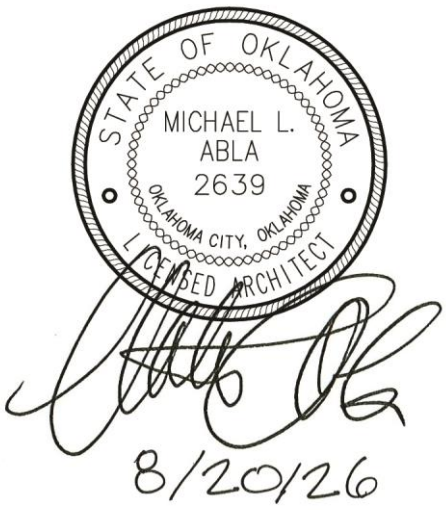


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Divisions 21, 22, 23
Dwayne McDonald Gordon
Mechanical Engineer
Salas O'Brien, Inc.
OK 30822 / EXP 02.28.2028
CA 9820/ EXP 06.30.2027



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Engineer of Record
Division 26
Timothy Van Ostran
Electrical Engineer
Salas O'Brien, Inc.
OK 32650 / EXP 03.31.2027
CA 9820/ EXP 06.30.2027



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NOTES:

1. These Technical Specifications shall be used in conjunction with the Drawings and the general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications.
2. Where conflicts occur between these Specifications and the applicable Standard Specifications or DOT standards, the more stringent requirements shall apply unless otherwise directed by the Engineer.
3. All materials, workmanship, and construction methods shall conform to the applicable requirements of the referenced standards and the authority having jurisdiction.
4. The Contractor shall coordinate all work with the Engineer, Owner, and applicable utility companies prior to commencement of any work under these Sections.

PREPARED FOR: AGP
PROJECT: MPS BOARDROOM
DATE: 07/24/26

Derek Harris, PE
Engineer / Architect



SPECIAL CONDITIONS

TIME FOR COMPLETION AND LIQUIDATED DAMAGES:

A. Upon execution of the contract agreement between the Owner and the Contractor, it shall become an obligation of the contractor to complete all work to be performed under this agreement for the Construction of the 2026 ASC Board Room / Storm Shelter Building to be located on the Moore Public Schools campus at 1500 Southeast 4th Street, Moore, OK - **within 300 Calendar Days.**

B. Penalty for noncompliance by the above date shall be cessation of all further periodical payments until the work is completed and can be fully used for the purpose intended.

PAYMENTS:

A. The Owner's payment schedule indicating the payment dates established by Moore Public Schools shall be provided to the contractor to establish a monthly payment schedule.

B. **Certificates of payment shall be submitted to the Architect on or before 7 days prior to Owner's cut-off date.**

C. Until the Work is 50 percent complete, the Owner will pay 95 percent of the amount due the Contractor on account of progress payments. At the time the Work is 50 percent complete, any **remaining** partial payments shall be paid at 97.5 percent of amount due. The retainage shall be retained until the project is completed.

INSURANCE AND BONDS:

A. Insurance provided shall be with a company or companies licensed to do business in the state of Oklahoma.

B. Policies shall be provided in the following types and amounts:

1. a. Workmen's Compensation-Statutory
   b. Employer's Liability-$500,000 each accident.

2. Comprehensive General Liability:
   a. Bodily Injury - $1,000,000 each occurrence.
   b. Personal Injury - $1,000,000
   c. Property Damage - $1,000,000 each occurrence

3. Automobile Liability:
   a. Bodily Injury - $500,000 each person/$1,000.000 each occurrence.

   b. Such Comprehensive Automobile Liability Insurance shall include all owned and non-owned hired motor vehicles.

4. Owner's Protective Liability - Same limits as above.

5. Products and Completed Operations - Same limits as above.

6. Contractual Liability - Same limits as above.

C. Furnish one copy of Certificates herein required for each copy of the Agreement; specifically set forth evidence of all coverage required by Subparagraphs 11.1 and 11.2. Furnish to the Owner copies of any endorsements that are subsequently issued amending coverage or limits.

D. T**he Contractor shall provide property insurance in the amount of the initial contract sum as well as subsequent modifications thereto for the entire Work at the site on a replacement cost basis without voluntary deductibles. This insurance coverage shall be the "all-risk" form for completed value.**

TEMPORARY SERVICES:

A. Sanitary Facilities: The Contractor shall provide and maintain necessary sanitary conveniences for the use of those employed on/or about the work. The sanitary facilities shall be properly secluded from public observation and shall be such locations as shall be approved by the Owner, and their use shall be strictly enforced.

SHOP DRAWINGS and SUBMITTALS:

A. Unless otherwise specified, the shop drawings and product data shall be submitted **electronically**. Physical samples of materials shall be submitted to the Architect as required.

B. Construction Manager is responsible for obtaining and distributing required prints of shop drawings to his subcontractors and material suppliers after as well as before

final approval.

C. Shop drawings and samples shall be dated and marked to show the names of the Project, Architect, CM, originating Sub-Contractor, manufacturer or supplier, and separate detailer if pertinent. Shop drawings shall completely identify Specifications section and locations at which materials or equipment are to be installed. Reproduction of Contract Drawings are acceptable as Shop Drawings only when specifically authorized in writing by the Architect &/or applicable Engineer/Consultant.

D. If materials or specified items other than those specified in these Contract Documents are supplied - and approved by the Architect - it shall be the Construction Manager's responsibility to provide **ALL** additional materials, accessories, substrates, utility connections, etc. for a complete and operational installation at **NO** additional cost to the Owner.

CHANGES IN THE WORK:

A. Cost shall be limited to the following: cost of materials, including sales tax and cost of delivery; cost of labor, including social security, old age and unemployment insurance, and fringe benefits under collective bargaining agreements; workmen's compensation insurance; bond premiums; and rental value of power tools and equipment. Overhead shall include the following; supervision, superintendence, wages of timekeepers, watchmen and clerks, hand tools, incidentals, general office expense, and all other expenses not included in "cost".

B. Subcontractor Change Order markups shall be limited to 10% overhead and 10% profit. No other markups shall be allowed.

Constructor Manager markups shall be limited to 7% profit UNLESS a time extension has been approved by the Owner and the Architect allowing for an increase of G.C.s as per original base agreement times the number of approved additional days. No other markups shall be allowed.

AS BUILT DRAWINGS:

A. Provide and maintain in proper order and in good, clean condition in the field office at the project site, one complete full-size set of all working drawings. On this set of drawing

prints, in red ink, neatly and accurately inscribe any and all changes in the work.

B. Upon completion of work, the Contractor shall furnish one set of **"as built"** drawings. These drawings shall be contract drawings corrected in **red ink** to show any differences between contract drawings and actual construction. All changes made during construction shall be noted. Each drawing showing changes in dimensions, details, or containing supplemental information shall be plainly marked **"As Built"** and shall contain the signature of both the Architect and the Contractor.

CLOSEOUT SUBMITTALS:

Prepare project data in the form of an instructional manual supplied electronically on media as requested by Owner (CD or flash drive). The following information shall be included and arranged under a Table of Contents:

1. Directory listing names, addresses, and telephone numbers of the Architect/Engineer(s), General Contractor, Subcontractors, and major material/equipment suppliers.
2. Operation and Maintenance Instructions arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and Suppliers. Include equipment, parts list for each, operating instructions, maintenance instructions for equipment, special finishes, etc.
3. Project documents and certificates, including shop drawings and product data, air and water balance reports, photocopies of warranties.
4. Record As-Built Drawings as described above.
5. Completed Non-Asbestos Affidavit.

DEBRIS DISPOSAL:

Waste disposal shall be the responsibility of the Contractor. The Contractor shall make arrangements with the local authorities having jurisdiction for accommodation of all waste disposal. If local facilities are not available, the contractor shall be responsible for all other arrangements for waste disposal.

SUPPLEMENTARY CONDITIONS AND SPECIAL CONDITIONS:

In the following sections where the term "General Conditions" is used, it shall include the "Supplementary Conditions" and/or "Special Conditions" bound in this project manual.

MISCELLANEOUS PROVISIONS:

A. TESTS AND INSPECTIONS

Add the following clarification: **Regardless of how it is described elsewhere in the drawings and specifications, the CM shall engage all testing laboratories / subcontractors as approved by the Architect; and, pay for ALL testing as required by the drawings and specifications.** The CM shall pay for any additional testing due to defective work. The Owner shall pay for any additional testing requested and found to be non-defective.

B. EQUAL OPPORTUNITY

The Contractor shall maintain policies of employment as follows:

The Construction Manager and all Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, or national origin. The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated fairly during employment without regard to their race, religion, color, sex, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment advertising; layoff or termination; rates of pay or any other forms of compensation; and selection for training, including apprenticeship. The CM agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

C. COOPERATION WITH BUILDING OFFICIALS

Cooperate with applicable Federal, State, City or other governmental officials and inspectors at all times. If such officials or inspectors deem special inspections are necessary, provide assistance and facilities that will expedite their inspection.

Construction Manager shall be responsible for obtaining and paying for ALL building permits required for this project. This cost shall be included in the Construction Manager's General Conditions.

D. MEASUREMENTS

Before doing any work or ordering any materials, the Contractor shall verify all measurements of existing and new work and shall be responsible for their correctness.

Quantities obtained during bidding &/or construction shall not be from the scaling of the drawings. Only dimensions obtained from dimensioned documents &/or existing on-site conditions shall be utilized for quantities determination, pricing, and ordering. Any scaling of the Construction Documents will be at the bidder's risk and any discrepancies shall be corrected by and paid for by the bidder.

If differences are found, they shall be submitted to the Architect for consideration and verification before proceeding with the work. No extra compensation will be allowed because of differences between actual dimensions and measurements indicated on the working drawings.

E. MANUFACTURER'S SPECIFICATIONS AND INSTRUCTIONS

Install all manufactured items of materials or equipment in strict accordance with manufacturer's recommended specifications, except that the specifications herein, where more stringent, shall be complied with.

At the completion of the project and prior to final acceptance by the Owner, provide the Owner with three complete sets of operating and maintenance instructions, and demonstrate to him the procedures for proper operation and maintenance of all equipment.

F. CONFLICTS BETWEEN DRAWINGS AND SPECIFICATIONS:

Conflicts between the drawings and specifications shall be brought to the immediate attention of the Architect. Failure to bid items(s) noted on the drawings and omitted from the specifications **does not** remove responsibility from the Construction Manager and applicable Subcontractor(s) to provide and install such with no additional cost to the Owner.

These Contract Documents – including but not limited to the Drawings, Project Manual, and any subsequent Addenda – are issued as a "whole" and shall be bid as such. Each

discipline / subcontractor shall review the **entire set** of Contract Documents and include applicable work in their bid **regardless of location within the Contract Documents.** Reviewing only a portion of the Contract Documents shall not absolve the construction manager or subcontractor of the requirements to perform all the work required of their respective disciplines and/or trade to provide a complete and properly functioning product, system, device, material, etc.

G. JOB MAINTENANCE

During the course of their work, all crafts and trades shall protect all work which preceded theirs from damage, and they shall make repairs or replacements to any damage caused either directly or indirectly by them.

H. COMPLIANCE WITH STATE AND FEDERAL LAWS

Construction Manager assumes full responsibility for the payment of all contributions and payroll taxes (state and federal) as to all subcontractors and employees engaged in the performance of work pursuant hereto and further agrees to check and meet all requirements that might be specified under regulations of the administrative officials or board charged with the enforcement of any state or federal act on the subject referred. CM agrees to furnish Owner, upon request, a certificate or other evidence of compliance therewith.

I. OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970 (OSHA)

The Construction Manager shall comply with the latest edition and revision of The Federal Occupational Safety and Health Act of 1970 for construction.

J. GUARANTY BONDS

1. Prior to the Owner signing the contract agreement, they will require the Construction Manager to furnish performance and payment bonds covering the faithful performance of the entire construction contract agreement. The performance bond and the payment bond shall each be made out in one hundred percent (100%) of the contract sum and shall be in a company or companies against which the Owner has no reasonable objection.

2. Bonds shall be signed by an official of the bonding company and shall be accompanied by the bonding agent's written power-of-attorney in order that one copy may be attached to each copy of the contract agreement.

3. The Construction Manager shall include in his proposal amount the total premiums for all required bonds.

4. Unless noted otherwise, the Construction Manager does hereby warrant and/or guarantee against defects in all workmanship and materials performed or furnished by him directly or by his subcontractors for a period of one (1) year from the date of completion, as evidenced by the date of the Final Certificate or final acceptance of the project. Said warranty and/or guarantee shall be in the form of a good and sufficient bond in a sum equal to one hundred percent (100%) of the contract price.

End of Special Conditions

Project Number: 05471500
March 15, 2019

Professional Service Industries, Inc.
11825 S. Portland Avenue
Oklahoma City, OK 73170
Phone: (405) 735-6052
Fax: (405)735-6086

Michael L. Abla, AIA
AGP-the Abla Griffin Partnership, LLC
201 North Broadway, Suite 210
Moore, OK 73160

Re: **Report of Geotechnical Engineering Services**
ASC Boardroom Storm Shelter Building
Moore Public Schools
Moore, Oklahoma
PSI Report No.: 05471500

Dear Mr. Abla:

Thank you for choosing Professional Service Industries, Inc. (PSI), an Intertek company. The information you requested is attached.

PSI performed the geotechnical exploration that you requested on December 18, 2018 PSI transmits the geotechnical report with this letter.

PSI thanks you for your business and looks forward to finding ways to grow our partnership, expand our services, and continue Building Better Together.

For Professional Service Industries, Inc.
CA NO. 1111 Expires 06/30/19

Ming-Cheng "Peter" Shau, P.E., D.GE
Department Manager
Geotechnical Services

Report of Geotechnical Engineering Services

ASC Boardroom Storm Shelter Building
Moore Public Schools
Moore, Oklahoma

Prepared for

AGP – the Alba Griffin Partnership, LLC
201 North Broadway, Suite 210
Moore, OK 73160

Prepared by

Professional Service Industries, Inc.
11825 S. Portland Avenue
Oklahoma City, OK 73170

March 15, 2019

PSI Project 05471500



Ming-Cheng "Peter" Shau, P.E., D.GE
Department Manager
Geotechnical Services

Darren W. Lantz
Principal Consultant
Geotechnical Services

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1 EXECUTIVE SUMMARY

This executive summary should be used in conjunction with the entire report for design and construction purposes. This section is for summary purposes only and specific details can be found in the report hereafter. This geotechnical engineering services report is for the proposed ASC Boardroom Storm Shelter Building in Moore, Oklahoma.

Based on the exploration, it is our finding that the proposed construction is feasible from a geotechnical standpoint, provided the recommendations contained herein are made a part of the plans and implemented during construction.

Site Conditions / Grading / Compaction	
ITEM	Conclusion & Recommendations
Soils	Lean & Fat CLAY with various sand content, over Sandstone bedrock
Groundwater	Observed Boring DB-1 at a depth of 7 feet during drilling and of 5 feet upon completion
Grading	Grade change of ±2 feet
Building Pad Thickness	Undercut and structure fill/Select Fill Thickness: 2 feet
Compact. Req.	95% of a Standard Proctor and moisture content range of -2% to 3%
Foundation Design – Seismic (IBC 2015)	
Site Class	C
Site Parameters	S_s= 0.269; S_1= 0.078; F_a= 1.2; F_v= 1.7
Spread Footings	
Net Allowable Bearing Capacity	2,500 psf for column footings 2,000 psf for continuous wall footings
Depth	24 inches (Frost Embedment)
Width	24 inches (Square) & 18 inches (continuous)
Mod. of Subgrade Reaction	120 pci based on 1-foot by 1-foot plate load test
Subsurface Preparation	Undercut 2 feet, Proof-roll, and moisture conditioned subgrade
Drilled Pier Foundation	
Unit End Bearing	See applicable report section
Unit Skin Friction	See applicable report section
Retaining Wall	See applicable report section
Pavement Design	
Asphalt	**Light Duty:** 1½" AC / 2½" AC / 4" Aggregate Base **Heavy Duty:** 2" AC / 3½" AC / 4" Aggregate Base
Concrete	**Light Duty:** 5" PCC / 4" Aggregate Base **Heavy Duty:** 6" PCC / 4" Aggregate Base

The owner/designer should not rely solely on this Executive Summary and must read and evaluate the entire contents of this report prior to utilizing PSI's engineering recommendations in preparation of design/construction documents.

2 PROJECT INFORMATION

2.1 PROJECT AUTHORIZATION

Professional Service Industries, Inc. (PSI) has completed a geotechnical exploration for the proposed ASC Boardroom Storm Shelter building at Moore public schools in Moore, Oklahoma. PSI's services were authorized by Mr. Michael Abla; AGP – the Abla Griffin Partnership, LLC by signing PSI's proposal on December 18, 2018. This exploration was accomplished in general accordance with PSI Proposal No. P0547-254843 dated August 31, 2018.

2.2 PROJECT DESCRIPTION

Limited project information was provided by Mr. Michael Abla of AGP. PSI understand the proposed project will be as follows:

Building:
- Structure designed per FEMA 361 and ICC 500 Standards
- Slab-on-grade construction
- No below grade/basement construction

Retaining Wall:
- Location of soil retention, if applicable, is unknown.

Pavement:
- Pavement design includes
    - Standard Duty pavement: Design life of 10 years, based on EAL (18 Kip) per day of 1.78 (13,000 EALs), terminal serviceability = 2.0, reliability 85%
    - Heavy Duty Pavement: Design life of 20 years, based on EAL (18 Kip) per day of 6.58 (48,000 EALs), terminal serviceability = 2.0, reliability 85%

Structural loading information is not available to PSI. This report is also based on the following:

Loads:
- Maximum column loads of 200 kips
- Maximum wall loads of 13 kips per lineal foot
- Maximum floor slab loads will not exceed 150 per square foot

Pavement:
- Both asphalt and/or Portland cement concrete pavement may be considered in the construction

Grading:
- Cut and/or fill on the order of 2 feet or less to achieve design building grade

2.3 PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to explore the subsurface conditions at the site and prepare recommendations for geotechnical design considerations for the proposed storm shelter and supporting structural construction. PSI's

scope of services included drilling a total of 2 soil test borings (DB-1 & DB-2) as requested, laboratory testing of select soil samples, and preparation of this geotechnical report. This report briefly outlines the testing procedures, presents available project information, describes the site and subsurface conditions, and includes the approximate boring locations, boring logs, and recommendations regarding the following:

- General site development and subgrade preparation.
- Foundation types and depths, allowable bearing capacities, and estimates of potential settlement.
- Soil retention system lateral resistance design parameters.
- Pavement design considerations.
- Seismic site class and site coefficients according to the 2015 IBC criteria.
- Comments regarding factors that will impact construction and performance of the proposed project.

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air, on or below, or around this site. Statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

PSI did not provide any service to investigate or detect the presence of moisture, mold, or other biological contaminants in or around any structures, or any service that was designed or intended to prevent or lower the risk of the occurrence or the amplification of the same. The client should be aware that mold is ubiquitous to the environment with mold amplification occurring when building materials are impacted by moisture. Client should also be aware that site conditions are outside of PSI's control, and that mold amplification will likely occur, or continue to occur, in the presence of moisture. As such, PSI cannot and shall not be held responsible for the occurrence of, or recurrence of, mold amplification.

Laboratory consolidation testing for detailed analysis of settlement characteristics is not included in the present scope of work. However, consolidation settlements are not anticipated to be an issue for this project site.

3 SITE AND SUBSURFACE CONDITIONS

3.1 SITE LOCATION AND DESCRIPTION

The project site is located at south west side of the existing Moore Public Schools in Moore, Oklahoma. The latitude and longitude for the site are approximately 35.33285°N and 97.46651°W, respectively. The site is bordered by the existing parking lot to the east, and un-develop areas to the west, north and south. The site is currently vacant and generally visually appears to be flat. The PSI truck-mounted drill rig did experience mobility difficulties during the field work. Due to the soft wet surface, a boring DB-1 was needed to be offset to complete the drilling work.

3.2 SUBSURFACE CONDITIONS

The site subsurface conditions were explored with two (2) soil test borings. The borings were located in the field by PSI's drilling crew by measuring distances from known site reference points, as closely as possible to the locations designated by the client.

The exploration was performed from a truck-mounted CME-55 drill rig equipped with an automatic hammer using a 140-pound hammer dropping 30 inches. Soil samples were routinely obtained during the drilling process. Drilling and sampling techniques were accomplished generally in accordance with ASTM procedures.

Select soil samples were tested in the laboratory for evaluation and determination of material properties including moisture content, Atterberg limits, and fines content. Laboratory testing was accomplished generally in accordance with ASTM procedures.

In general, the overburden primarily consists of lean and fat clay with varied sand contents, and silty sand over sandstone bedrock to the boring termination depths. Please refer to the attached boring logs for more specific information. The following table briefly summarizes the range of results from the field and laboratory testing programs:

General Range of Material Property Values						
Soil Description	Approx. Depth Range, ft.	Standard Penetration, N, blows/foot	Texas Cone Penetrometer, inch/100 blows	Moisture Content, %	Percent Fines (Passing # 200 Sieve)	Liquid Limit, % Plastic Limit, % Plasticity Index
Lean CLAY (Varied Sand)	0 - 7½	7 - 25	-	16 – 24	-	LL= 40 PL= 20 PI= 20
Fat CLAY (Varied Sand)	2½ - 5	10	-	25	98.5	LL=54 PL=25 PI=29
Silty Sand	0 - 6	9 - 30	-	10 - 20		
SANDSTONE	6 - 15½	PR*	0.88 - 3.88	11 - 20	-	-

*PR-Practical Refusal

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in the **Appendix** should be reviewed for specific information at the boring locations. The boring logs include soil/rock descriptions, stratifications, penetration resistances, and locations of the samples. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during field operations is also shown on the boring logs. The samples that were transported to the laboratory will be retained for 60 days from the date of this report and then discarded.

3.3 GROUNDWATER INFORMATION

Groundwater was observed to collect in a boring DB-1 at a depth of 7 feet at the time of the drilling and at a depth of 5 feet upon completion. Groundwater was not observed in a boring DB-2, indicating that the depth to water is below the boring extents or that a greater response time is required to allow the water to collect in the open holes. Groundwater can exist at varying depths during other times of the year depending upon climatic and rainfall conditions. Discontinuous zones of perched water can exist within the overburden materials and/or at the contact with bedrock.

4 EVALUATION AND RECOMMENDATIONS

4.1 GEOTECHNICAL DISCUSSION

The geotechnical related recommendations presented in this report have been developed on the basis of the subsurface conditions encountered and PSI's understanding of the proposed project. Should changes in the project criteria occur, a review must be made by PSI to determine if modifications to the recommendations will be required. The performance of the construction will be dependent upon the shear strength of the underlying soils.

There is a geotechnical related condition at this site that is expected to potentially impact performance of grade supported floor slabs in the areas of the proposed construction. This condition regards the medium high to high shrink/swell potential near surface soils and the concern is addressed below.

4.1.1 SWELL POTENTIAL CLAYS

The primary concern involves medium high to high shrink/swell potential clay that was encountered in the borings. The medium high to high shrink/swell potential soil material is expected to exhibit significant volume changes with variations in subgrade moisture. The calculated Potential Vertical Rise (PVR) for slab-on-grade construction at this project location is on the order of approximately 1 to 1¼ inch. This value is based on the shrink/swell potential subgrade material being allowed to increase in moisture content from a relatively dry condition to a relatively wet condition or allowed to shrink from a relatively saturated condition to a dry state over a depth of approximately 10 feet (the estimated moisture active depth.) The relatively dry condition can occur with severe dry weather situations, thereby resulting in a significant degree of shrinkage and potential swell of the foundation material when wet again. Differential movements are expected to be about ½ of the PVR for this type of clay. However, it should be noted that for extreme conditions (i.e., soils dry and shrink in one area with soils in another area being exposed to water and swelling) differential movement can be equal to or even double the PVR.

A reduction in the potential vertical movement can be achieved by supporting the floor slab on a minimum 2 feet of properly compacted low plasticity structural fill soil to reduce the calculated PVR to ¾ inch or less. The desired thickness of fill can be provided by raising the site grade with the properly compacted recommended materials or by undercutting and replacing with the recommended backfill materials. It should be noted that, to avoid the possible "bathtub effect" created by granular structural fill replacing over-excavated (undercut) relatively low permeability clay material, the structural fill materials in undercut areas, at a minimum, should be relatively impermeable or the existing shrink/swell potential clay soils can be stabilized with cement, lime or fly ash, and used as fill at least to replace the undercut. Structural fill and/or stabilized soil conforming to the guidelines presented in the **"Site preparation"** section of this report should be used. The greater the engineered fill thickness beneath the slab, the less the probability of structural distress due to shrinkage and swelling of the clay soils. Proof-rolling and visual observation, as discussed later in this report, should be accomplished to aid in identifying soils which should be removed from building area prior to fill placement and floor slab construction.

4.1.1.1 CEMENT, LIME, OR FLY ASH STABILIZATION

The medium high to high shrink/swell potential clay subgrade soils may be stabilized with Portland cement, hydrated lime, or Class 'C' fly ash from a source approved by ODOT and used as fill or structural fill and also in order to reduce potential for "bathtub" effect. Stabilizing the soil with an estimated 5 to 7 percent cement or

lime or an estimated 12 to 14 percent fly ash, by dry weight, will reduce the potential volumetric changes due to the medium high to high shrink/swell potential soil. The actual cement, lime or fly ash percentage should be determined based on laboratory tests after the source of the stabilizing agent has been determined.

4.2 SEISMIC INFORMATION

The 2015 International Building Code requires a site class for the calculation of earthquake design forces. This class is a function of soil type (i.e. depth of soil and strata types). Based on the type of materials encountered to the boring termination depths and the estimated shear strength of the soil at the boring locations, Site Class C is recommended. The USGS-NEHRP probabilistic ground motion values near this site are as follows:

Seismic Design Parameters			
Period (seconds)	2% Probability of Event in 50 years (g)	Site Coefficient F_a	Site Coefficient F_v
0.2 (S_s)	0.269	1.2	N/A
1.0 (S_1)	0.078	N/A	1.7

The Site Coefficients, F_a and F_v, were interpolated from IBC 2015 Tables 1613.3.3(1) and 1613.3.3(2) as a function of the site classification and the mapped spectral response acceleration at the short (S_s) and 1 second (S_1) periods.

4.3 SITE PREPARATION

Soft and loose soil, and deleterious materials in the construction areas, should be stripped from the site and either wasted or the soil portion stockpiled for later use in non-load bearing areas such as landscaping. Additional undercutting should be performed in the building area as necessary to allow for the recommended thickness of structural and/or stabilized fill soils beneath the floor slab. The depth of removal should be observed and documented by a representative of the Geotechnical Engineer at the time of construction. Wet soils encountered should be removed and replaced or worked in place to allow for adequate drying and replacement.

After stripping and excavating to the proposed subgrade level, the construction area should be proof rolled with a tandem axle dump truck or similar rubber-tired vehicle. Soils which are observed to rut or deflect excessively (typically greater than 1 inch) under the moving load (typically 9 tons/axle) should be undercut and recompacted in place or replaced with properly compacted engineered fill. The recompacted soil or imported structural fill should be moisture conditioned during placement. The proof-rolling and undercutting activities should be witnessed by a representative of the Geotechnical Engineer and should be performed during a period of dry weather.

After proof-rolling and correcting soft areas or areas exhibiting rutting or pumping, the native subgrade soils should be scarified and compacted for a depth of at least 8 inches below the surface.

After subgrade preparation and testing have been completed, fill placement that will be required to establish site design grades should begin. The first layer of fill material should be placed in a relatively uniform horizontal lift and adequately keyed into the stripped and scarified subgrade soils. PSI recommends fill materials be free of organic or other deleterious material, have a maximum particle size less than 3 inches, have a liquid limit not more than 40 and plasticity index between 5 to 20 with percentage of fine passing the No. 200 sieve not less than 60 percent, at least in replacing undercut areas. The on-site soils are generally not suitable for use as structural fill without stabilization as recommend but may be stockpiled for later use in non-load bearing areas

such as landscaping. Accurate moisture control will be required to achieve the recommended degree of compaction. Structural fill should be compacted to at least 95 percent of standard Proctor maximum dry density as determined by ASTM D698.

Fill should be placed in maximum lifts of 8 inches of loose material and should be compacted at a moisture content ranging from -2 to +3 percentage points of optimum moisture content. Stabilized soils should be compacted at least 2 percentage points above the optimum moisture content value. If water must be added, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying. Each lift of compacted engineered fill should be tested by a representative of the Geotechnical Engineer prior to placement of subsequent lifts. The edges of compacted fill should extend a minimum of 5 feet beyond the edges of the proposed building prior to sloping. Care should be taken to apply compactive effort throughout the entire fill area.

For structural fill, PSI recommends that such fill be tested by a Geotechnical Technician and directed by a Geotechnical Engineer to monitor and document the placement of fill material. It should be noted that the Geotechnical Engineer of record can only certify the testing that is performed, and the work observed by that engineer or staff in direct report to that engineer. PSI recommends that the fill be monitored in general accordance with the following table:

Recommended Fill Compaction Criteria				
Material Tested	Proctor Type	Min % Dry Density	Placement Moisture Content Range	Frequency of Testing
Structural Fill /Select Fill	Standard (or Modified)	95%	-2 to +3 %	1 per 2,500 ft^2 of fill placed
Stabilized Existing Soils	Standard	95%	≥+2	1 per 2,500 ft2 of fill placed
Random Fill (Non-Load Bearing)	Standard	90%	-2 to +3 %	1 per 10,000 ft^2 of fill placed
Utility Trench Backfill	Standard	95%	-2 to +3 %	1 per 200 cy of fill placed

A minimum of 3 field density tests per lift is recommended. If the borrow or source of fill changes, a new reference moisture/density test should be performed.

The overall performance of the construction will also depend on how well the site drains during the construction and the life of the structure. Grading of the site around the structure's pads should be accomplished to enable positive drainage away from the pads by providing an adequate gradient. The surface gradient provided will be dependent on the landscaping type and vegetation. Water infiltration and seepage into the foundation should be avoided as much as possible. If it is possible for water to collect beneath the foundation and foundation areas, it will be necessary to use interceptor drains to remove the collected water.

Excavation for utility trenches should be performed in accordance with OSHA regulations as stated in 29 CFR Part 1926. It should be noted that utility trench excavations have the potential to degrade the properties of the adjacent fill materials. Utility trench walls that are allowed to move laterally can lead to reduced bearing capacity and increased settlement of adjacent structures and structural elements.

Backfill for utility trenches is as important as the original subgrade preparation or structural fill placed to support foundations. Unless otherwise specified, the backfill for the utility trenches should be placed in 4 to 6-inch loose lifts and compacted to a minimum of 95% of the maximum dry density achieved by the standard Proctor test. The backfill soil should be moisture conditioned in the range of 2 percentage point below to 3 percentage points above the optimum moisture content value as determined by the standard Proctor test. Up to 4 inches of sand bedding material placed directly under the pipes or conduits can be used for the leveling purposed. Other than sand bedding materials if structural fill/select fill placed directly under the pipes should be compacted to the 90% compaction criteria with respect to standard Proctor maximum dry density. Compaction testing should be performed for every 200 cubic yards of backfill placed or for each lift within 200 linear feet of trench, whichever is less. Backfill of utility trenches should not be performed with water standing in the trench. Structural fill should be used as the trench backfill material.

4.4 DRILLED PIER FOUNDATION RECOMMENDATIONS

The subgrade materials encountered in the borings can be divided into 3 soil/rock strata with the overburden clay composing upper material, Stratum I (Silty Sand, Lean Clay with sand, and Lean Clay), Stratum II (Fat Clay), and Stratum III (Sandstone Bedrock). The piers should be founded a minimum depth of 2 feet into Stratum III, as applicable, and should be a minimum length of 10 feet below the grade beam or wall as applicable. The piers founded as recommended can be designed for allowable unit end bearing and allowable unit skin friction capacities presented in the table below, based on dead load plus design live load. The skin friction capacities are applicable to the portion of drilled shaft extended a minimum 2 feet or one pier diameter, whichever is larger, below the recommended bearing material. The allowables are based on factors of safety of 2 and 3 for end bearing and skin friction, respectively.

Recommended Drilled Pier Bearing Capacity				
Boring No.	Soil/Rock Strata	Depth, ft.	End Bearing Capacity, psf	Skin Friction Capacity, psf
DB-1	I	0 - 2½	-	-
	II	2½ - 5	-	-
	III	6 - 10½	28,000	2,100
DB-2	I	0 - 3½	-	-
	I	3½ - 8	-	-
	III	8 - 14½+	28,000	2,100

Note: The allowable skin friction values are applicable to drilled piers that extend a minimum 2 feet or one pier diameter below top of sandstone bedrock.

Pier uplift forces from swelling soils can be resisted by the skin friction values recommended plus an allowance for pier weight and the dead load of the structure supported. Drilled piers should be adequately reinforced (entire length recommended.) Reinforcement quantity should be adequate to resist tensile uplift forces generated by the clay soils equal to 800 psf over the upper 8 feet of the pier shaft.

The piers should be designed after considering the dead load and the uplift force within the active depth. Piers should be designed with a shaft diameter of at least 18 inches. Properly constructed piers bearing in the recommended materials are expected to experience total maximum settlement on the order of ½ inch.

It may be difficult for the drilling contractor to determine or identify proper recommended bearing materials or strata. Therefore, it is recommended PSI perform the pier construction observations and documentation.

The pier construction should also be observed by a representative of the Geotechnical Engineer to assess that the foundation materials have adequate strength to support the design loads and are consistent with the materials recommended in this report. Particular attention should be given to observation at locations where soil sloughing or groundwater inflow problems may occur.

Soft or loose soil zones, if encountered at the bearing level should be removed from the drilled shafts. If the exposed bearing material becomes significantly wet or dry, it should be removed, and the pier deepened until more uniform moisture conditions are achieved. Concrete should be placed in the piers the same day they are excavated to prevent weakening of the shaft wall and bottom.

Although not anticipated based on soil conditions encountered during PSI's site work at the time of drilling, slurry and/or casing may be required to advance the drilled piers, especially if sloughing soil or when groundwater is encountered. Concrete placed in the piers should have a slump in the range of 5 to 7 inches. This range of slump will help to reduce the potential for formation of voids, especially as casing is extracted. The concrete mix should be designed to attain the required strength when placed at such a slump. The drilled shafts should be filled with concrete as soon as practical to reduce the potential of groundwater related problems and weathering of the excavation wall. During simultaneous concrete placement and casing removal operations, sufficient concrete head should be maintained inside the casing to offset hydrostatic head outside the casing, and to prevent the intrusion of soil and possible groundwater into the pier concrete, if present.

4.4.1 LATERAL RESISTANCE DESIGN PARAMETERS

If lateral load consideration is applicable as part of the drilled pier construction and service conditions, the following section provides the necessary geotechnical related information that may be considered in the pier design. For drilled piers, the soils as well as the rigidity of the pier will resist the lateral loads applied to the shaft. Lateral load analysis can be performed based on methods ranging from chart solutions to the 'p-y' approach utilizing computer programs such as LPILE or the public domain COM624.

The lateral design information regarding the 'p-y' data is provided in this section. The relationship between the soil resistance (p) and pile deflection (y) is commonly referred to as 'p-y'. Along the depth of the shaft, soil resistance (p) is expressed as a non-linear function of lateral shaft deflection (y). Various researchers developed 'p-y' criteria for different kinds of soils. The 'p-y' curves can be automatically generated utilizing the computer program LPILE or the public domain COM 624. The program LPILE was developed by Lymon Reese and Shin-Tower Wang, Ensoft, Inc. and based on the COM 624 developed for the FHWA by the authors and made available by the FHWA. The parameters for generation of 'p-y' criteria from LPILE as well as COM 624 are provided for the analyses of the shafts.

Parameters to Be Used in the Lateral Load Analyses					
Stratum	'p-y' Criteria	Total Unit Weight**, (pcf)	Su (psf) or Ø (deg.)	Ks & Kc or Ksat. & Kunsat. (pci)	ε50
I*	Sand Criteria	110	Ø = 30°	Kunsat. = 35 or	-

				Ksat. = 25	
I*	Lean Clay Criteria	120	Su = 1,800	Ks = 610 or Kc = 240	ε50 = 0.0064
II	Fat Clay Criteria	130	Su = 3,000	Ks = 2,000 or Kc = 800	ε50 = 0.0040
III	Bedrock Criteria	135	Qu = 15,000	-	Krm = 0.0005

Note: Su: Undrained Shear Strength (psf); Qu: Unconfined Uniaxial Compressive Strength (psf); Ks: modulus of subgrade reaction (pci) for static loading condition; Kc: modulus of subgrade reaction (pci) for cyclic loading condition; Kunsat: modulus of subgrade reaction (pci) for unsaturated subgrade condition; Ksat: modulus of subgrade reaction (pci) for saturated subgrade condition; E: Elastic modulus (psi); ε50: strain corresponding to one-half the principle stress. Krm: a constant for overall stiffness; RQD: Rock Quality Designation.

* Neglect the top 3' or a pier diameter, whichever is larger, of Stratum I soils for the lateral load analysis appropriately based on the location of the pile head

** For submerged portion of pier, use effective unit weight

*** Applicable subgrade material type should be based on the actual elevation relative to the construction

If required, PSI can assist in performing the lateral response analysis under a separate work proposal.

4.5 SHALLOW FOUNDATION RECOMMENDATIONS

If considered, spread footings for columns and continuous wall footings bearing at a minimum depth of 2 feet below the final grade, for frost protection, can be designed for allowable unit bearing pressures of 2,500 psf and 2,000 psf, respectively, based on dead load plus design live load. The allowable for continuous foundation is also applicable for the retaining wall stability analysis.

It is important that PSI observes and documents the footing excavations prior to concrete placement. Minimum dimensions of 24 inches for square footings and 18 inches for continuous wall footings should be used in design of the footings to reduce the possibility of a local bearing capacity failure.

The foundation excavations should be observed by a representative of PSI prior to steel or concrete placement to document that the foundation materials are consistent with the materials discussed in this report. Soft, loose and or wet soil zones, if encountered, at the bottom of the footing excavations should be removed to the level of acceptable residual soils or adequately compacted structural fill as directed by the Geotechnical Engineer. The bottom of the footings should be probed to identify and locate soft areas. Cavities formed as a result of excavation of soft or loose soil zones should be backfilled with lean concrete or properly compacted structural fill.

The uplift resistance of the foundations will be limited by the weight of the foundation concrete and soil above them and the dead weight of the structure. For design purposes, the ultimate uplift resistance should be based on effective unit weights derived from presumptive total unit weights of 120 pcf and 150 pcf for soil and concrete, respectively. A factor of safety of 2 should be applied to the uplift resistance.

Footing excavations should be observed, and concrete placed as quickly as possible to avoid exposure of the footing bearing surfaces to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond. If possible, the foundation concrete should be placed during the same

day the excavation is made. If footing excavations are left open for more than 1 day, they should be protected to reduce evaporation or entry of moisture.

Based on the known subsurface conditions, site geology, laboratory testing, anticipated loading, and allowable bearing pressures, properly designed and constructed footings supported on the recommended materials should experience maximum total and differential settlements between adjacent columns of less than 1 inch and ¾ inch, respectively.

4.6 FLOOR SLAB RECOMMENDATIONS

The building grade supported floor slabs used in conjunction with the drilled pier or conventional spread footing should be supported on the properly prepared and compacted recommended structural fill or stabilized existing soil used as structural fill. When supported by the minimum one foot of properly compacted structural fill or stabilized existing soil, the Potential Vertical Rise (PVR) for a grade supported floor slab is expected to be ¾ inch or less. Proof-rolling, as discussed earlier in this report, should be accomplished to identify soft or unsuitable soils that should be removed from the floor slab areas prior to fill placement and floor slab construction. Fill soils under the slabs should be moisture conditioned at or above the optimum moisture content throughout the construction process.

For the properly compacted structural fill and modified existing soil, modulus of subgrade reaction, k, value of 120 pounds per cubic inch (pci) may be used in the grade slab design based on a 1 ft. x 1 ft. plate load test. However, depending on how the slab load is applied, the value will have to be geometrically modified. The value should be adjusted for larger areas using the following expression for cohesive and cohesionless soils:

Modulus of Subgrade Reaction,

$$k_s = \frac{k}{B} \text{ for cohesive soil, and}$$

$$k_s = k\left(\frac{B+1}{2B}\right)^2 \text{ for cohesionless soil (not recommended in undercut)}$$

where:

k_s	=	coefficient of vertical subgrade reaction for loaded area,
k	=	coefficient of vertical subgrade reaction for 1x1 square foot area,
B	=	width of area loaded, in feet (or effective width, B', for grade beam, continuous footing, or mat/raft foundation)

PSI recommends that a minimum four-inch thick free draining granular mat be placed beneath the building floor slabs to enhance drainage. Prior to placing drainage layer, the subgrade should be graded to drain and not provide pockets to trap water. In moisture sensitive areas for equipment and flooring, vapor retarder should be installed with the grade supported slab construction according to ACI criteria. The floor slabs should have an adequate number of joints to reduce cracking resulting from differential movement and shrinkage.

4.7 PAVEMENT RECOMMENDATIONS

The PSI scope of services did not include extensive sampling or CBR testing of the existing subgrade or potential sources of imported fill for the specific purpose of detailed pavement analysis. Instead, PSI has estimated pavement related design parameters that are considered to be typical for the area and soil types.

The recommended sections presented below are considered minimum for the pavement design parameters used. PSI understands that non-technical considerations sometimes result in thinner pavement sections than those presented. However, the client, the owner, and the project principals should be aware that thinner pavement sections might result in increased maintenance costs and lower than anticipated pavement life. The pavement subgrade should be prepared as discussed in the "Site Preparation" section of this report.

Pavement sections were evaluated using Pavement Assessment Software (PAS) which is based on the 1993 AASHTO Design equations. Pavement design parameters proposed by client include the following for flexible (asphalt) pavement section:

- Standard Duty pavement: Design life of 10 years, based on EAL (18 Kip) per day of 1.78 (13,000 ESALs), terminal serviceability = 2.0, reliability 85%
- Heavy Duty Pavement: Design life of 20 years, based on EAL (18 Kip) per day of 6.58 (48,000 ESALs), terminal serviceability = 2.0, reliability 85%

PSI has estimated initial serviceability value of 4.2 in the new pavement analysis. Additionally, an overall standard deviation value of 0.45 and a presumptive subgrade resilient modulus value of 3,000 psi was also idealized in the flexible pavement evaluation. The recommended minimum flexible pavement sections for light and heavy-duty usage are presented in the following table:

Flexible Pavement Thickness (Inches)		
Pavement Materials	Light Duty	Heavy Duty
Asphaltic Surface Course	1½	2
Asphaltic Base Course	2½	3½
Aggregate Base	4	4

PSI is providing rigid pavement design section for the client's information. Minimum rigid pavement section recommended by PSI for sidewalk is 5 inches. Rigid pavement evaluated based on an initial serviceability of 4.2, a terminal serviceability of 2.0, overall standard deviation of 0.35, and an unreinforced concrete mix with a 28-day modulus of rupture of 550 psi (approximately 3,500 psi compressive strength) will yield the presented sections provided in the table below.

The pavement sections presented for the rigid pavements represent minimum thickness recommendations by PSI and the ESAL loads are in excess of 0.25 million. PSI should be contacted if traffic loads, especially truck traffic in loading areas and the frequency idealized, are greater than used in the analysis. Pavement materials should conform to local and state guidelines, if applicable.

Rigid Pavement Thickness (Inches)		
Pavement Materials	Light Duty	Heavy Duty
Portland Cement Concrete	5	6
Aggregate Base	4	4

PSI has based its pavement recommendation on subgrade soils prepared to achieve a minimum CBR value of 3, with proper proof-rolling and the site not being wet at the time of construction.
Rigid concrete pavement seven (7) inches in thickness over four (4) inches of aggregate base, is recommended where trash dumpsters or semi-trailers are to be parked on the pavement or where a considerable load is transferred from relatively small steel wheels. This should provide better distribution of surface loads to the subgrade with minimal deformation of the surface.

Pavement may be placed after the subgrade has been properly stabilized, compacted, fine graded and proof-rolled. The work should be done in accordance with the Oklahoma State Department of Transportation guidelines.

If aggregate base is used, water should not be allowed to pond behind curbs and saturate the base stone. In down grade areas, the aggregate base should extend through the slope to allow water entering the base stone a path to exit.

4.7.1 PAVEMENT SUBGRADE PREPARATION

Prior to paving, the prepared subgrade should be proof-rolled using a loaded tandem axle dump truck or similar type of pneumatic tired equipment with a minimum gross weight of nine (9) tons per single axle. Localized soft areas identified should be repaired prior to paving. A smooth drummed roller compactor, as previously recommended, may be required due to the granular nature of the site soils. Moisture content of the subgrade should be adequately maintained at the time of paving. It may require rework and modification when the subgrade is either desiccated or wet or pumps.

Construction traffic, including foot traffic, should be minimized to prevent unnecessary disturbance of the pavement subgrade. Disturbed areas, as verified by PSI, should be removed and replaced with properly compacted material.

4.7.2 PAVEMENT DRAINAGE AND MAINTENANCE

PSI recommends pavements be sloped to provide rapid surface drainage. Water allowed to pond on or adjacent to the pavement could saturate the subgrade and cause premature deterioration of the pavements, and removal and replacement may be required. Consideration should be given to the use of interceptor drains to collect and remove water collecting in the granular base. The interceptor drains could be incorporated with the storm drains of other utilities located on-site.

Periodic maintenance of the pavement should be anticipated. This should include sealing of cracks and joints and maintaining proper surface drainage to avoid ponding of water on or near the pavement areas.

5 CONSTRUCTION CONSIDERATIONS

5.1 EXCAVATIONS

The following is provided in this report for the client's information. In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavations or footing excavations, be constructed in accordance with the new OSHA guidelines. It is PSI's understanding that these regulations are being strictly enforced and if not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and Federal safety regulations.

PSI is providing this information solely as a service to the client. PSI does not assume responsibility for construction site safety or the contractor's compliance with local, state, and Federal safety or other regulations.

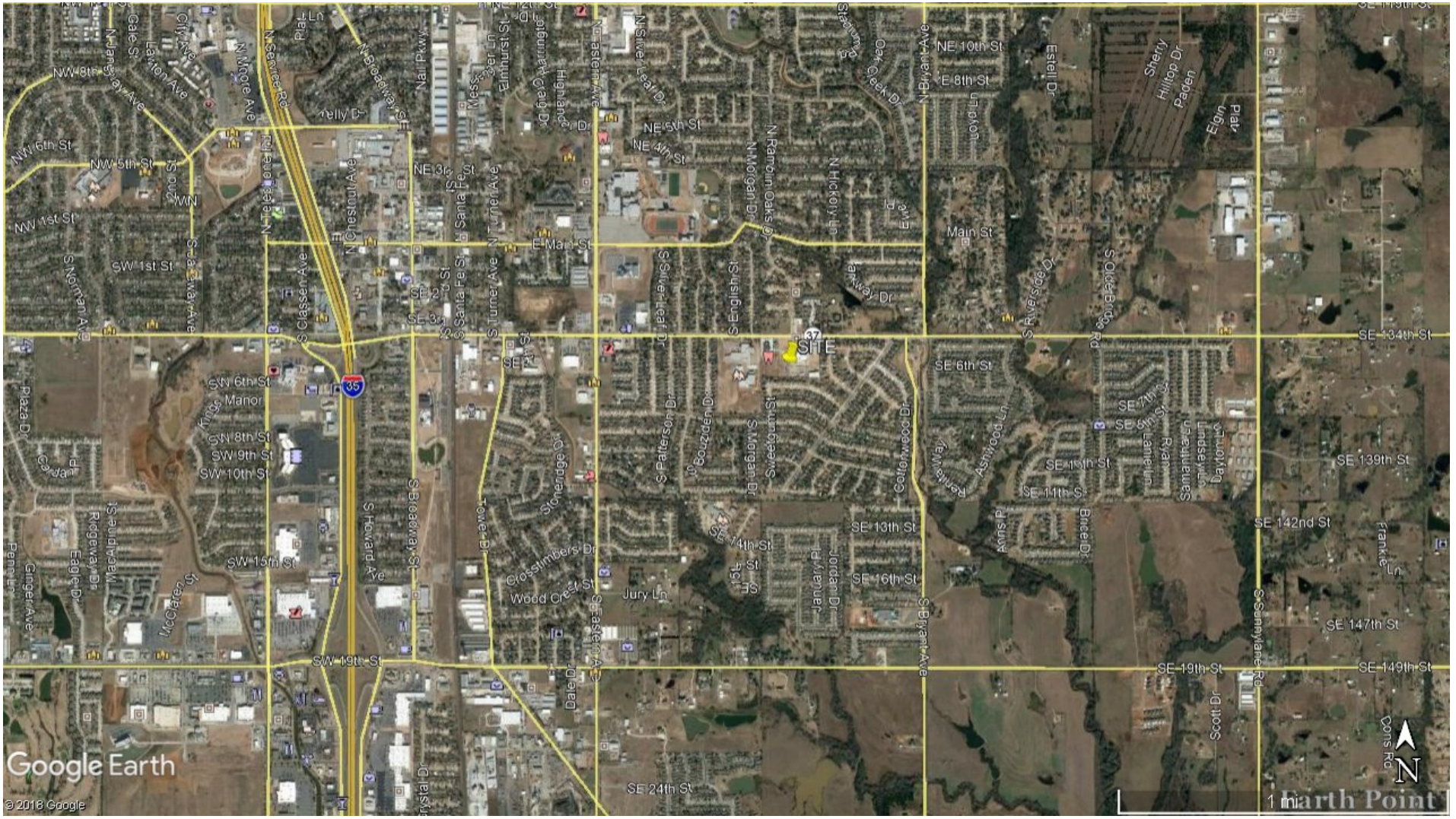
6 REPORT LIMITATIONS

The recommendations submitted are based on the available subsurface information obtained by PSI and details furnished by AGP – the Abla Griffin Partnership, LLC for the proposed project. If there are revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes in the foundation recommendations are required. If PSI is not retained to perform these functions, PSI will not be responsible for the impact of those conditions on the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the Geotechnical Engineer should be retained and provided the opportunity to review the final design plans and specifications to check that PSI's engineering recommendations have been properly incorporated into the design documents. At this time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of AGP – the Abla Griffin Partnership, LLP and KFC Engineering for the proposed ASC Boardroom Storm Shelter Building in Moore, Oklahoma.

FIGURES



intertek psi	*Project* ASC BOARDROOM STORM SHELT—MOORE, OK	
	Drawing SITE VICINITY	*Project No.* 05471500
	Drawn By Y. Zhang	*Figure* **FIGURE 1**
	Date February 2019	



intertek psi	*Project* ASC BOARDROOM STORM SHELT—MOORE, OK	
	Drawing BORING LAYOUT PLAN	*Project No.* 05471500
	Drawn By Y. Zhang	*Figure* **FIGURE 2**
	Date February 2019	

APPENDIX A – BORING LOGS

BORING DB-1

DATE STARTED:	1/21/19
DATE COMPLETED:	1/21/19
COMPLETION DEPTH	10.0 ft
BENCHMARK:	N/A
ELEVATION:	N/A
LATITUDE:	35.33285°
LONGITUDE:	-97.46651°
STATION:	N/A
OFFSET:	N/A
REMARKS:	

DRILL COMPANY:	PSI, Inc.
DRILLER:	B. Rodgers
LOGGED BY:	C. Bevers
DRILL RIG:	CME-55
DRILLING METHOD:	Solid Flight Auger
SAMPLING METHOD:	SS/TC
HAMMER TYPE:	Automatic
EFFICIENCY	N/A
REVIEWED BY:	P. Shau

Water

While Drilling	7 Ft.
Upon Completion	5 Ft.
Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS) Texas Cone (TC)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ Moisture × PL ◪ LL ✚ 0 25 50 STRENGTH, tsf Qu ▲ Qp ✳ 0 2.0 4.0	Additional Remarks
	0			1		**Lean CLAY with Sand**, brown, fine roots			24	×	
						Lean CLAY with Sand, stiff, reddish-brown, fine roots					
				2	18			3/3/4 N=7	20	× ◎	
						Fat CLAY, stiff, red					
				3	18		CH	4/4/6 N=10	25	× ◪ ✚ >> ◎	LL = 54 PL = 25 Fines=98.5%
-5	5					**Silty SAND**, medium dense to dense, light reddish-brown					
				4	16			11/30 50 (4.50")	10	× >> ◎	
						(Rock) **SANDSTONE**, hard to very hard, light reddish-brown					
				4				50 (1.00") 50 (0.63")	11	× >> ◎	
-10	10			5		End of boring		50 (2.38") 50 (1.50")	20	× >> ◎	

intertek psi

Professional Service Industries, Inc.
11825 S. Portland Avenue
Oklahoma City, OK 73170
Telephone: (405) 735-6052

PROJECT NO.:	05471500
PROJECT:	ASC Boardroom Storm Shelter
LOCATION:	Moore Public Schools
	Moore, OK

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING DB-2

DATE STARTED:	1/14/19	**DRILL COMPANY:**	PSI, Inc.
DATE COMPLETED:	1/14/19	**DRILLER:** B. Rodgers	**LOGGED BY:** C. Bevers
COMPLETION DEPTH	15.0 ft	**DRILL RIG:**	CME-55
BENCHMARK:	N/A	**DRILLING METHOD:**	Solid Flight Auger
ELEVATION:	N/A	**SAMPLING METHOD:**	SS/TC
LATITUDE:	35.33278°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-97.46642°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	P. Shau

REMARKS:

Water

While Drilling	None observed
Upon Completion	None observed
Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS) Texas Cone (TC)	Moisture, %
	0			**Silty SAND**, brown, fine roots			
		1		**Lean CLAY with Sand**, stiff, reddish-brown, fine roots			20
		2	18			3/3/4 N=7	22
		3	18	**Lean CLAY**, very stiff, red		5/7/10 N=17	21
-5	5	4	18		CL	6/10/15 N=25	16
		5	14	**Silty SAND**, dense, red		9/30 50 (2.38")	11
				(Rock) **SANDSTONE**, hard to very hard, red			
-10	10	5				50 (0.75") 50 (0.50")	11
				...white layer at 12'			
-15	15	6		End of boring		50 (0.63") 50 (0.25")	11

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0

Additional Remarks

LL = 40
PL = 20
Fines=90.0%

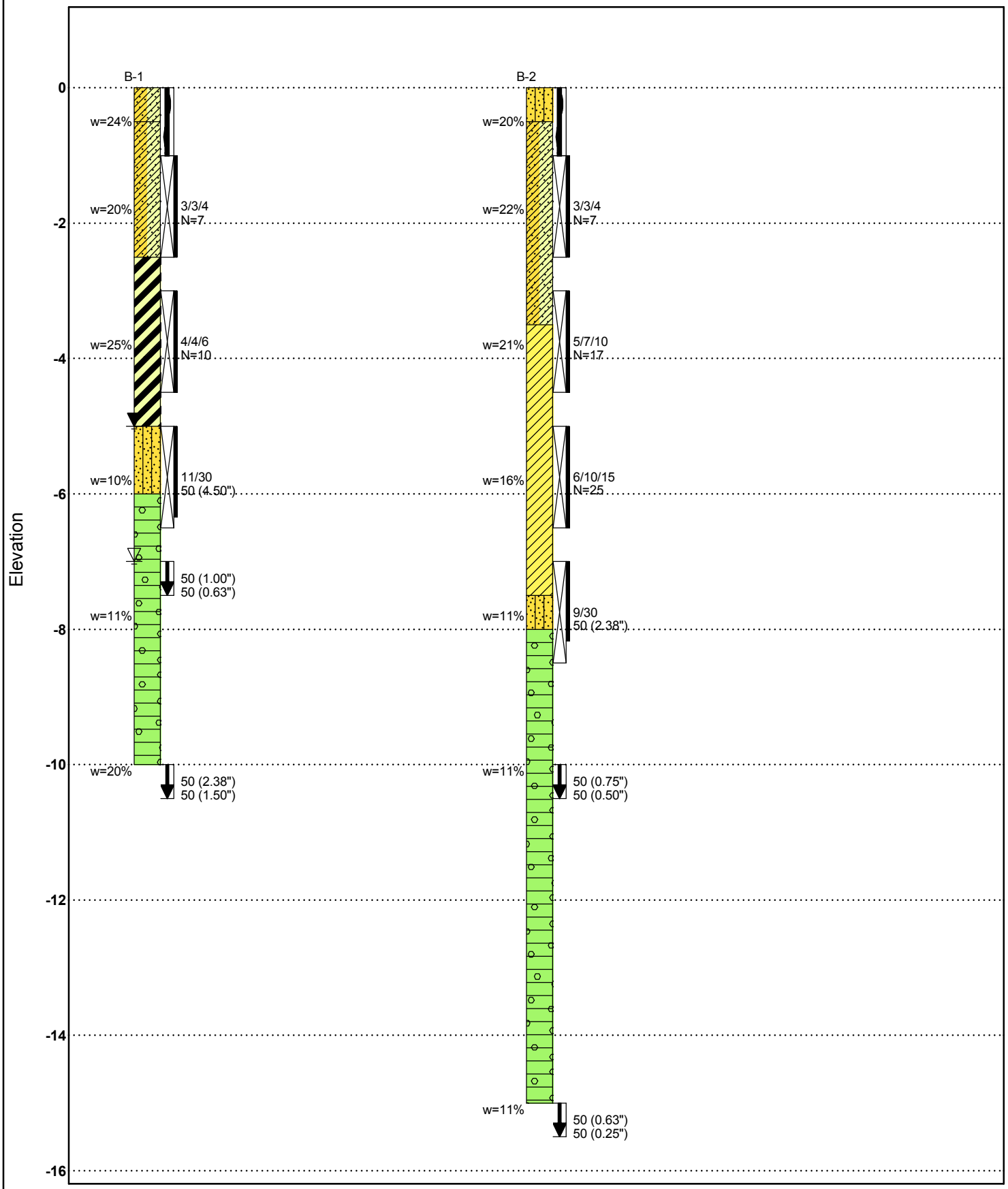
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Professional Service Industries, Inc.
11825 S. Portland Avenue
Oklahoma City, OK 73170
Telephone: (405) 735-6052

PROJECT NO.: 05471500
PROJECT: ASC Boardroom Storm Shelter
LOCATION: Moore Public Schools
Moore, OK

The stratification lines represent approximate boundaries. The transition may be gradual.

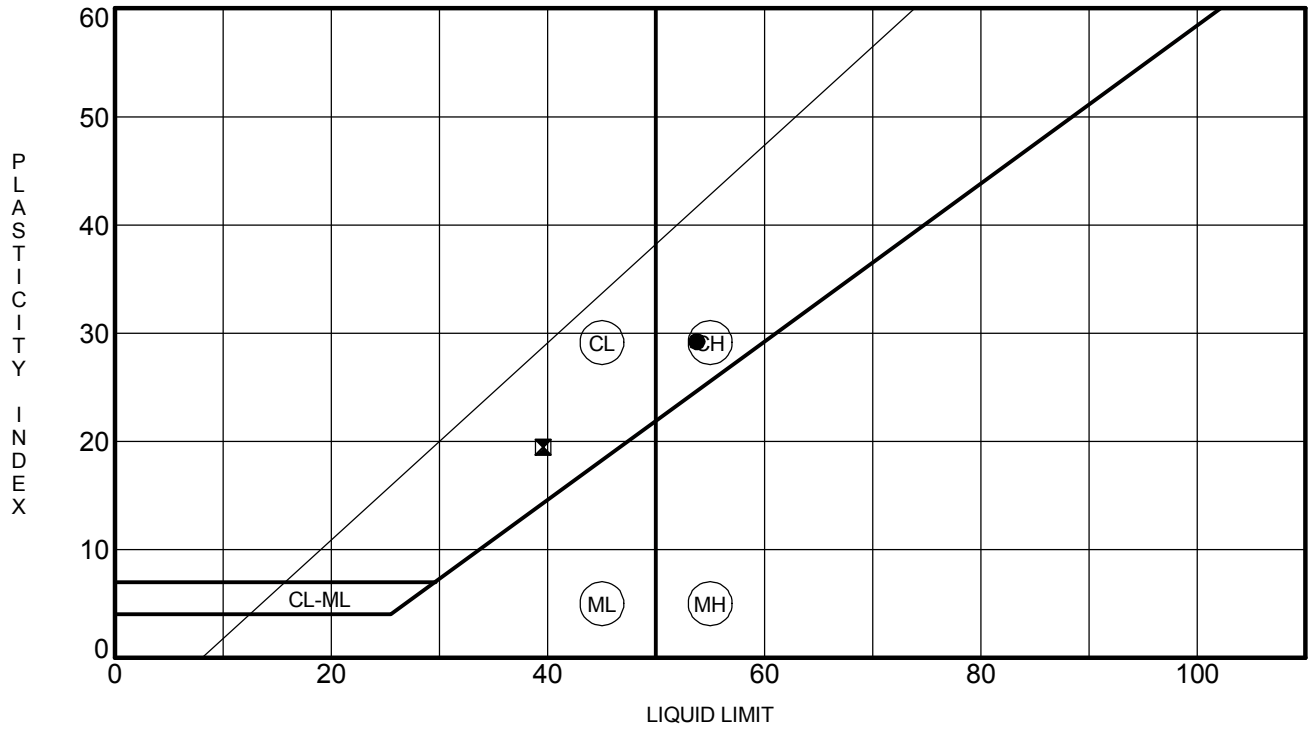
Profile



Professional Service Industries, Inc.
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ASC Boardroom Storm Shelter
PSI Project Number: 05471500

APPENDIX B – LABORATORY TEST REPORTS



	Boring	Depth (ft)	LL	PL	PI	Fines	Classification (*Visual)
●	**DB-1**	**3.8**	**54**	**25**	**29**	**98.5**	**Red Fat CLAY**
⊠	**DB-2**	**5.8**	**40**	**20**	**20**	**90.0**	**Red Lean CLAY**

Professional Service Industries, Inc.
11825 S. Portland Avenue
Oklahoma City, OK 73170
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Fax: (405) 735-6086

ATTERBERG LIMIT RESULTS

PSI Job No.: 05471500
Project: ASC Boardroom Storm Shelter
Location: Moore Public Schools
Moore, OK

APPENDIX C – GENERAL NOTES

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
RC: Rock Core
TC: Texas Cone
BS: Bulk Sample
PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,▼ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 3
Loose	4 - 9
Medium Dense	10 - 29
Dense	30 - 49
Very Dense	50+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

Q_U - TSF	N - Blows/foot	Consistency
0 - 0.25	0 - 1	Very Soft
0.25 - 0.50	2 - 3	Soft
0.50 - 1.00	4 - 6	Medium Stiff
1.00 - 2.00	7 - 12	Stiff
2.00 - 4.00	13 - 26	Very Stiff
4.00 +	26+	Hard

MOISTURE CONDITION DESCRIPTION

Description	Criteria
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term	% Dry Weight
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

Description	Criteria
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided:	Fracture planes appear polished or glossy, sometimes striated
Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed:	Inclusion of small pockets of different soils
Layer:	Inclusion greater than 3 inches thick (75 mm)
Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

Q_U - TSF	Consistency
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

Description	Criteria
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

Voids	Void Diameter
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

Component	Size Range
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

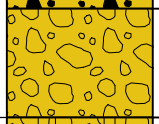
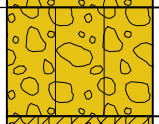
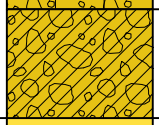
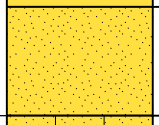
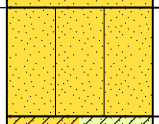
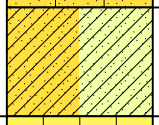
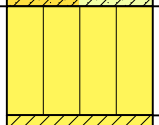
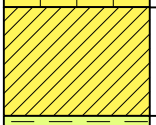
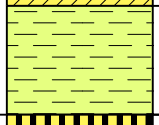
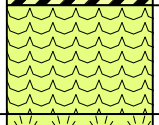
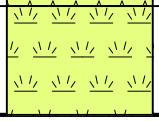
Rock Mass Description	RQD Value
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

DEGREE OF WEATHERING

Slightly Weathered:	Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.
Weathered:	Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.
Highly Weathered:	Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

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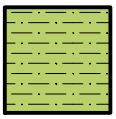
Graphic Symbols for Materials and Rock Deposits



CONCRETE
Portland Cement Concrete



BITUMINOUS CONCRETE



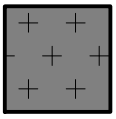
CLAYSTONE



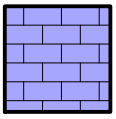
COAL
Coal, Anthracite Coal



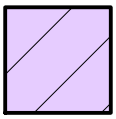
CONGLOMERATE/BRECCIA
Conglomerate, Breccia



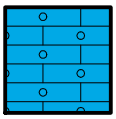
IGNEOUS ROCK
Anorthsite, Basalt, Metabasalt, Diabase (Gabbro), Gabbro, Granite/Granodionite, Homfels, Pegmatite, Rhyolite/Metarhyolite



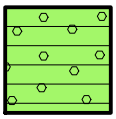
LIMESTONE
Limestone, Dolomite



METAMORPHIC ROCK
Amphibolite, Gneiss, Marble, Phyllite, Quartzite, Schist, Serpentinite, Slate



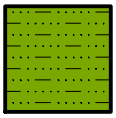
CHERT



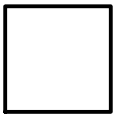
SANDSTONE
Sandstone, Orthoquarzite (Sandstone)



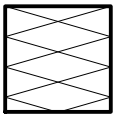
SHALE



SILTSTONE



NO RECOVERY



VOID

intertek
psi

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01010-SUMMARY OF THE WORK

Part 1 - General

1.01 Work Included:

A. The General Conditions, Bidding Requirements, and Division I are hereby made a part of each of the technical sections that follow and shall be understood to apply and shall apply in full to all individuals or corporations who contract or subcontract to perform any part or all of the project work.

B. Indications on the working drawings or in any section of the specifications of an article or material, operation, or method, requires that the Contractor shall provide each item or service or quality or is subject to qualifications noted; and, the Contractor shall perform each operation prescribed according to the conditions stated providing, therefore, all necessary labor, equipment, and incidentals to complete the project work.

C. The project:

1. Name: New ASC Boardroom / Storm Shelter Building – Moore Public Schools.
2. Location: 1500 Southeast 4th Street, Moore, Oklahoma.

1.02 Summary of Work:

A. **Base Bid:** Provide and pay for all materials, labor, services, equipment, licenses, taxes, permits, and other items necessary for the complete construction of a (approximately) 7,969 s.f. new school board meeting facility (with associated facilities, office / meeting room, storm shelter, etc.) including new sidewalks, and site utilities. Contractor shall maintain all barriers, guards and other environmental items required at the site during construction.

B. Owner: Moore Public Schools

1. Owner's Representative:
   Jeff Horn, Bond Consultant
   Moore Public Schools
   1500 SE 4th Street
   Moore, OK 73160
   405-735-4221

C. Design Team:

1. Architect:
   Mike Abla, Principal Architect / Clay Griffin, Principal Project Manager
   AGP
   313 S.E. 5th Street
   Moore, OK 73160
   405-735-3477
2. Structural Engineer:
   Brandon Birch, Structural Engineer
   KFC Engineering, Inc.
   1300 N. Walker, Suite 200
   Oklahoma City, OK 73103
   405-528-4596

3. Mechanical, Electrical and Plumbing Engineers:
   Dwayne Gordon, Mechanical Engineer
   Salas O'Brien
   2900 S. Telephone Rd., Suite 120
   Moore, OK 73160
   405-364-9926
4. Civil Engineer:
   Derek Harris, Civil Engineer
   Flatland Civil Consulting
   3005 Golden Valley Road
   Norman, OK 73072
   405-863-8984
5. Construction Management Team:
   Joe Sherga, Project Manager
   Omni Construction LLC
   P.O. Box 892245
   Oklahoma City, OK 73189
   405-735-3992

1.04 Work to be Provided and Installed By Others:

A. Provision and installation of office and boardroom furniture except as noted otherwise.

1.05 Use of the Site:

A. Confine operations at the site to the areas permitted under the contract. Portions of the site beyond areas on which work is indicated are not to be disturbed.

B. Keep facility free from accumulation of waste material, rubbish, or construction debris.

1.06 Safety of Persons and property:

A. Contractor shall at all times protect the building from damage from rainwater.

B. Contractor shall provide barricades and clearly mark work zone areas.

C. Refer to Special Conditions "Temporary Services" for additional information.

D. During the period of construction, the OSHA Standards shall be followed as applicable by law.

E. The Contractor shall post emergency telephone numbers.

1.07 Preconstruction Conference:

A. A preconstruction meeting will be held at a time and place designated by the Architect or Owner=s Representative, for the purpose of identifying responsibilities of the Owner's and the Architect=s personnel and explanation of administrative procedures.

B. The Contractor shall use this meeting for the following minimum agenda:

1. Construction Schedule/Project Phasing.
2. Use of areas of the site.
3. Delivery and storage.
4. Safety.
5. Security.
6. Cleaning up.
7. Subcontractor procedures relating to:

a. Submittals.
b. Change orders.
c. Applications for payment.
d. Record documents.

C. The attendees shall include:
1. The Owner's Representatives.
2. The Architect.
3. The Construction Manager and its superintendent.

1.08 Project Scheduling:

A. The Contractor is responsible for the scheduling of construction and must prepare a schedule and charting system described below. This schedule is to ensure adequate planning and execution of the work by the contractor and to assist the Architect in appraising the schedule and evaluating the progress of the work.

B. The project schedule shall be presented within ten (10) days after receipt of the Notice to Proceed. Three (3) copies of the schedule shall be submitted to the Architect for review and approval.

C. The schedule logic must be in the form of a "fenced" bar chart or Critical Path Method network indicating the planned start and completion dates of the activity, logical constraints between activities, and total float of each activity.

D. An updated project schedule shall be provided when requested by the Architect.

1.09 Environmental Controls:

A. Water Resources:
1. Oily substances: prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water.
2. Mosquito abatement: prevent ponding of stagnant water conducive to mosquito breeding habitat.

B. Land Resources:
1. Erodible soils: plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use the areas developed. Immediately protect side slopes and back slopes upon completion of rough grading.

C. Air resources:
1. Prevent creation of dust, air pollution, and odors.
2. Use water sprinkling, temporary enclosures, and other appropriate methods to limit dust and dirt rising and scattering in air to locate practical level.
3. Store volatile liquids, including fuels and solvents, in closed containers.
4. Properly maintain equipment to reduce gaseous pollutant emissions.

D. Comply with all applicable environmental control guidelines as required by the City of Moore.

1.10 Temporary Utilities:

A. The Contractor shall provide and pay for all temporary utilities required for the complete construction of the

project including, but not limited to, electricity, lighting, heating, cooling, ventilating, telephone, water, sanitary facilities, exterior and interior enclosures, access roads and parking areas, cleaning and waste removal, project identification and signs, etc.

1.11 Cleaning:

A. Use cleaning materials and agents recommended by manufacturer or fabricator of surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property, or that might damage finished surfaces.

B. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of work to condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer=s published instructions.

C. Complete cleaning operations prior to requesting a Final / Substantial Completion Inspection.

1.12 Project Sign:

A. Provide and install painted (all sides and edges) 3/4” exterior plywood project sign on 4”X4” wooden posts securely erected at the project site in a location approved by the Owner.

B. No other project signs or advertisement shall be allowed at the project site unless approved by the Owner.

C. Graphics and form of letter of the project sign shall be as indicated in the attached detail.

End of Section

DIVISION 2 - SITE WORK

SECTION 02110 - TEMPORARY CONSTRUCTION FENCING

Part 1 - General

1.01 Summary
- A. Section includes: Erection, maintenance and dismantling of temporary fencing around construction site and materials storage areas. This section does not apply where security fencing is required.
- B. Refer to Drawings for temporary fencing layout and location of gates.

1.02 Submittals
- A. Submit the following:
  1. Shop drawing indicating layout of temporary fencing, location and size of gates, existing pavement and roads, access to fire hydrants and hose connections, and other site specific conditions. Prepare drawing after site observation and verification of existing conditions.

Part 2 - Products

2.01 Temporary Chain Link fencing:
- A. Unless otherwise indicated, type of temporary chain link fencing shall be Contractor's option. Following types are acceptable:
  1. New materials or previously used salvaged chain link fencing in good condition.
  2. Posts: Galvanized steel pipe of diameter to provide rigidity. Post shall be suitable for setting in concrete footings, driving into ground, anchoring with base plates, or inserting in precast concrete blocks.
  3. Fabric: Woven galvanized steel wire mesh. Provide in continuous lengths to be wire tied to fence posts or prefabricated into modular pipe-framed fence panels.
  4. Height: Minimum Height shall be 8'-0".
- B. Gates: Provide personnel and vehicle gates of the quantity and size indicated on the Drawings or required for functional access to site.
  1. Fabricate of same material as used for fencing.
  2. Vehicle gates:
     a. Minimum width: 20 feet to allow access for emergency vehicles.
     b. Capable of manual operation by one person.

Part 3 - Execution:

3.01 Layout:
- A. Installation of temporary fencing shall not deter or hinder access to existing and new hose connections and fire

hydrants.
1. Maintain 3 feet diameter clear space around fire hydrants.
2. Where fire hydrant or hose connection is blocked by fencing, provide access gate.

B. Access: Provide gates for personnel, delivery of materials, and access by emergency vehicles.

3.02 Installation:

A. Chain link posts:
1. Space at 10'-0" maximum.
2. Drive posts, set in holes and backfill, or anchor in precast concrete blocks.
3. For soft and unstable ground conditions, cast concrete plug around post.
4. Posts over pavement: Use steel post plates or precast concrete blocks.
5. Gate posts: Use bracing or concrete footings to provide rigidity for accommodating size of gate.

B. Fabric: Securely attach to posts.

C. Gates: Install with required hardware.

D. Plastic mesh fencing: Space steel support posts to ensure mesh remains vertical and at proper height. Securely tie mesh to posts.

3.03 Maintenance and Removal:

A. Maintain fencing in good condition. If damaged, immediately repair.

B. Remove temporary fencing upon completion of Work or when no longer required for security or control. Backfill holes and compact. Holes in pavement shall be surfaced to match existing paving. Repair damage caused by installation of temporary fencing.

End of Section

DIVISION 2 – SITE WORK

SECTION 02811 - UNDERGROUND SPRINKLER SYSTEM

Part 1 - General

1.01 Work Included:

A. The General / Special Conditions and applicable sections of Division 1 shall apply to this entire section.

1.02 Summary:

This section includes the installation of an irrigation system for tree plantings and turf areas as shown on the Drawings. Components to be installed include, (but not limited to) design of the irrigation system, connection to water supply, main lines, lateral lines, trenching, backfilling, backflow device, automatic controller, bubblers, automatic drain valves, control wiring, fittings, electrical connections, zone valves, manual valves, sleeves under paving, piping, wire decoders, sensors and all necessary accessories to provide a complete operational system.

A. Contractor shall become familiar with the existing site conditions and other construction activities. Coordinate with the Owner's Representative on current construction activities, utilities, and other construction trades.

B. All planting bed areas shall be zoned independently from turf and tree zones.

1.03 Related Sections:

A. Section 02900 - Trees and Turf.

B. Section 02920 – Landscape Grading.

C. Section 02970 - Landscape Establishment

1.04 References:

A. American Society for Testing and Materials (ASTM):

1. D1785-83 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40 and Class 200
2. D2241-84 -Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
3. D2287 -Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
4. D2466-78 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
5. D2564-80 -Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
6. D2855-83 -Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
7. D3139-84 -Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

B. National Standard Plumbing Code.

C. National Electric Code - NFPA 70.

SECTION 02811 - UNDERGROUND SPRINKLER SYSTEM

1.05 Definitions:

A. Distribution: Diameter of Coverage - diameter of the surface area receiving water (pertains to full or part circle).

B. Irrigation Heads:

1. Fill-in - heads not located on the basic symmetrical pattern and/or which may not have the same coverage as the heads in the pattern.
2. Ports - The element within the dripper line which controls the amount of water to the plant or area in the subsurface irrigation system.
3. Pop-up Rotor (if required) - water-lubricated, gear-driven head installed flush with the turf, containing a nozzle which rises four (4) inches above the turf when operating.
4. Pop-up Spray - spray head installed flush with the turf or mulch, containing a nozzle which rises four (4) inches above the turf Spray - head containing a nozzle that discharges a fine uniform water spray.
5. Strip - spray head designed for watering long, narrow strips of turf or landscaping, usually in a square or rectangular pattern.

C. Lines:

1. Header - water line leading off from a zone valve; subject to pressure only when zone is operating.
2. Lateral - water line leading off from a header to a head.
3. Main - water line under constant pressure, supplying the sprinkler zones.

D. Valves:

1. Automatic Drain - a low pressure valve used to drain main and lateral lines.
2. Manual - a valve used to activate/terminate flow to a zone.
3. Zone - a section of heads controlled by one valve.

1.06 Design Criteria:

A. General:

1. The system shall be a two wire controlled system with controller and remote controlled valves as manufactured by Hunter Industries or equal. Main line shall be drained with manual drains at all low points, while zones shall be drained automatically at all low points.

2. The irrigation system design shall specify manufacturer, types of heads, spray nozzles and bodies, and valves to be used. These items shall determine line sizes, types of heads, valve sizes, number of zones and coverage. Manufacturers may be provided as listed in these specifications with similar precipitation rates and GPMs. Changes in pipe sizing, amount of pipe, number or size of valves, number of heads, number of sleeves and other accessories shall be at no additional cost.
3. For design purposes, the following minimum water coverage shall be provided:
    1. Turf Areas - 95 percent of sodded area indicated to be sprinkled.
    2. Other planting areas - 85% percent.
4. Main line shall be manually drained, with manual valves at all low points. Lateral lines shall be automatically drained, with automatic drain valves at all low points.

B. Sleeves:
1. Required number of sleeves shall be provided as required and indicated by the Irrigation System Design. Any additional sleeves required during system installation will be provided at no additional cost to the Owner.
2. Sleeves and Boring under Sidewalks: The Contractor shall add additional sleeves as necessary to insure proper operation of the irrigation system.

C. Two Wire Irrigation System Requirements:
1. Provide Hunter ICD-100 through ICD-600 station decoders – or equal - with surge suppression and ground wire as needed to group irrigation remote control valves.
2. Locate (1) grounding rod every 500 feet along wiring/main line or as per manufacturer’s recommendations. Locate ground rods a distance of 12’ perpendicular to the mainline. Locate (1) grounding rod at irrigation controller. Locate grounding rods in valve boxes.
3. Provide 14 AWG/1.6 mm diameter twisted decoder wire in sheathed casing as provided by Hunter Industries. Hunter Industries wire must be used to maintain warranty provided by Hunter. Provide DBR6 or DBY6 wire fittings manufactured by 3M for connection of decoders to valve connections and

decoders to two wire system. Wire runs shall not be looped.

4. Install two wire irrigation systems as per manufacturer's recommendations to provide a complete and operational system.
5. Prior to construction of irrigation system, irrigation contractor to shall prepare shop drawings showing valve groupings and wiring path diagrams for review and approval by the Architect.

1.07 Quality Assurance:

A. Irrigation Contractor shall be a single firm with over 7-years of documented experience in all aspects of irrigation work; irrigation maintenance and capable of installing irrigation system of this scope. Wire manufacturer's representative shall provide assistance to irrigation contractor to successfully execute the proper installation of a complete and operational two wire irrigation system. System shall be installed according to the specification requirements.

B. General: Irrigation contractor shall install all elements of the irrigation system including pipe sleeving, piping, heads, valves, wiring, valve boxes, controller, sensors, decoders, and other items necessary to operate the system.

1.08 Work Coordination:

A. Scheduling and Existing Information:

1. Schedule and coordinate all related activities to ensure completion of this work in the most expeditious manner.
2. The Contractor shall assume responsibility for locating all site utilities and perform work in a manner to avoid damage. Contractor shall coordinate location of all existing utilities within the project area with "Okie" as indicated on the Drawings. Contractor is responsible for keeping the utilities clearly marked, updated and protected.
3. Coordination Drawings: the Contractor shall provide and keep up-to-date a complete set of "Record Drawings" which shall be corrected daily to indicate changes in the location of heads, controllers, backflow preventers, valves, drains, meters, points of connection, pull boxes and wire splice boxes, pipe and wire routing and other changes that may have been made from the original shop drawings.

1.09 Submittals:

A. Shop Drawings: Submit complete irrigation design, indicating, mainline routing, lateral line routing, all remote control zones, a valve/zone schedule reflecting valve size and total gpm's, rotor head types (with nozzle sizes), spray head types (w/nozzle type), bubblers, gate valves, master valves, controller and backflow device locations.
   1. Provide documentation indicating certification of that piping meets tests specified herein.

B. Operations and Maintenance (O&M) Data:
   1. Operation and maintenance data shall be bound into three (3) individually bound hardback binders and properly indexed. Three (3) electronic copies saved to disk will also be provided. O&M data shall include at least the following:
      a. The index sheet shall indicate the Installer's name, address, and telephone number.
      b. Manufacturer's specifications, and description, and O&M information for all system components.
      c. Routine recommended maintenance activities of the entire system including weekly, monthly, semi-annual, seasonal and annual activities.
      d. A schedule of the measured or calculated flow rates for each zone, and a recommended controller setting and a schedule of times and duration of operation for each zone for each month or season based on a stated recommended precipitation requirement for the type of turf or plants and the geographical location of the installation.

C. Literature or Product Items include:
   1. Schedule 40 Sleeves
   2. Class 200 Laterals
   3. PVC Fittings - Schedule 40
   4. Flexible Vinyl Chloride Pipe
   5. PVC Solvent Compound
   6. Swing Joints
   7. Rotor Irrigation Heads
   8. Spray Irrigation Heads
   9. Zone Valves
   10. Gate Valves
   11. Automatic Drain Valves (Laterals)

12. Wiring
13. Wire Connectors
14. Valve Boxes
15. Identification Tape
16. Wireless Rain/Freeze Sensor
17. Wire decoders
18. 6” Pop up Bubblers for Tree Plantings
19. Tracer Wire
20. Backflow Preventer

D. Complete Record Drawings:
   1. Installed conditions.
   2. Two dimensions to each remote control valve, gate valves, etc. from two secure points.

1.10 Protection of Existing Conditions:

A. Contractor shall make every effort to protect existing items to remain.

B. Any existing structures, equipment, utilities, pavement, irrigation zones (all areas on campus), existing and proposed landscaping, etc., damaged by the Contractor during the course of the work, including any subsequent damage caused by equipment activity, leakage or settling of piping shall be restored at the Contractor's expense and to the Owner’s satisfaction.

1.11 Warranties:

A. Provide Manufacturer’s Standard Warranty each irrigation component.

B. One (1) year warranty period shall start upon final acceptance of the completed underground irrigation system.

C. Settlement – as a part of the work under this contract, if within the specified warranty period settlement occurs and adjustments to pipes, valves and sprinkler heads, planting or paving are required to meet the proper level of the permanent grade, the Contractor shall make all adjustments without additional cost to the Owner, including the complete restoration of all damaged planting, paving and other effected improvements of any kind.

Part 2 - Products

2.01 General:

A. Product Schedules: Submit a complete list of products to be incorporated in the work. List shall include catalog numbers, cuts, diagrams, and such other descriptive data as may be required by the Landscape

Architect prior to the submission of product data. Approval of products under this provision shall not be construed as authorizing any deviations from the specification unless attention has been directed in writing to the specific deviation. No consideration will be given to partial lists submitted from time to time. Approval of products will be based on manufacturer's published ratings. Products listed that are not in accordance with these specification requirements will be rejected.

B. Standard Products: Products furnished shall be standard products of manufacturers regularly engaged in the production of such products and shall be manufacturers' latest standard design that complies with the specification requirements.

C. Delivery and Storage: Products delivered to site shall be inspected for damage, unloaded, and stored with the minimum of handling. Do not store products directly on the ground. Inside of pipes and fittings shall be kept free of dirt and debris.

D. Handling: Products shall be handled in such a manner as to insure delivery to the trench in a sound undamaged condition. Pipe shall be carried to the trench, not dragged. Gasket materials and plastic materials that are not to be installed immediately shall not be stored in the direct sunlight. Valves, controller, sprinkler heads, etc., shall be removed from protective cover only upon installation.

2.02 Pipe and Fittings:

A. Pipe and fittings: Shall be PVC plastic unless otherwise specified. Pipe and fittings shall be rated for a minimum working pressure of 150 psi and a minimum hydrostatic pressure of 200 psi.

B. PVC Plastic:

1. Pipe shall conform to ASTM D1785, Schedule 40 and Class 200, Class 12454-B, PVC 1120. Fittings for use with Class 200 pipe shall conform to the requirements of ASTM D2464 or D2467. Fittings for schedule 40 pipe shall be solvent weld socket type conforming to ASTM D2466.
2. Main Lines: Schedule 40
3. Lateral Lines: Class 200
4. Sleeves Under Paving: Schedule 40
5. Flexible vinyl chloride pipe: from laterals to heads.

C. Fittings: Fittings for Solvent Welded Pipe: Provide Schedule 80 polyvinyl chloride, ASTM D2467 standard

weight, solvent weld fittings for pressured and main lines.

1. Manufacturer: SLOANE, LASCO, and SPEARS.

D. Swing Joints (for use with Quick-Couplers):

1. The full circle swing joint shall be rated at 200 psi maximum working pressure at 73_F. The swing joint shall be molded of rigid poly(vinyl) chloride (PVC), Type 1; with N.P.T. threads and pipe sockets. Each rotating joint shall be sealed with a nitrile (or equivalent material) rubber O-ring, installed pre-compressed in a sealing groove free of parting lines to prevent leakage. Modified stub threads shall have special engineered diameters and clearances to allow full-circle (360_) movement and to reduce stress concentrations and joint fracture at threaded roots.
2. Lay length shall be a minimum of 24-inches and pipe has a diameter of 1-inch.
3. Inlet configurations shall be socket and outlet configuration shall be M.I.P.T.
4. Manufacturer:
   a. LASCO

2.03 Valves:

A. Zone Valves: Valves shall be pressure regulating and sized as shown on Drawings. Valves shall be manufactured by HUNTER INDUSTRIES or approved equal.

B. Gate Valves:

1. Bronze gate valves smaller than 3 inches shall conform to MSS SP-80, Type 1, Class 150.

C. Manual Drain Valve: Valves shall be brass or bronze globe valves conforming to MSS SP-80.

D. Automatic Drain Valves:

1. Valves shall be spring-loaded, plunger type.
2. Manufacturer: KING TECHNOLOGY or approved equal.

D. Brass Hydrant:

1. Brass Hydrants shall be as shown on the Drawings and manufactured by Arrowhead or approved equal.

2.04 Control Wires:

Provide 14 AWG/1.6 mm diameter twisted decoder wire in sheathed casing as provided by Hunter Industries. Provide DBR or DBY wire fittings manufactured by 3M for connection of decoders to valve connections and decoders to two wire system. Wire runs shall not be looped.

2.05 Valve Boxes:

A. Boxes shall be high impact-strength plastic. Boxes shall have a lockable cover. Two keys shall be

furnished with each system for each type of box provided. Cover to be green in lawn areas and box enclosure to be black in color. Size boxes based on consolidation of remote control valves. Acceptable manufacturers include:

1. AMETEK
2. RAIN BIRD
3. CARSON
4. NATIONAL DIVERSIFIED SALES, INC.

B. Box Sizes:

1. Zone Valves: Standard Box with extensions as required or larger.
2. Brass Hydrant, Gate Valves, and Manual Drain Valve: 10” Round.

2.06 Identification Tape / Tracer Wire (all piping):

A. Provide underground-type plastic line markers, manufacturer's standard permanent, bright-colored continuous printed plastic tape, intended for direct burial service; not less than six (6) inches wide by four (4) mils thick. The tape shall be purple with black printing reading "CAUTION NONPOTABLE IRRIGATION WATER LINE BURIED BELOW".

B. Contractor shall provide 14 gauge Tracer insulated wire with all mainlines, running from automatic controller along the electrical lines to each valve. All splices in the tracer line will be with waterproof connectors. Contractor will have to splice into the existing tracer line at the main water line with waterproof connectors. The tracer line will follow mainlines, all main lateral lines, all two wire paths that do not run along the mainline.

C. Acceptable manufacturers include:

1. PRESCO PRODUCTS, Sherman, TX, 800.527.3295 or approved equal.

2.07 Sprinkler Heads - refer to 1.05 Definitions above:

A. Bubbler Sprinkler Heads shall be trickle type bubbler with adjustable flow and designed for permanent below ground mounting on risers in perforated, drain rock filled pipe at all tree wells, per locations on the Drawings.

B. Spray Pop-Up Heads:

1. Rotary Type Sprinkler Heads (if required): pop-up type, fully adjustable for flow and pressure, with letter or symbol designating degree of arc and arrow indicating center of spray pattern. Head with pattern to suit landscape layout.
2. Spray Pop Up Shrub Heads: 4”-12” pop-up type,

fully adjustable for flow and pressure, full, half and quarter arc as applicable. Head with pattern to suit landscape layout.

C. Acceptable manufacturers include:
   1. RAINBIRD or approved equal.

2.08 Water:
   A. During construction and testing of the irrigation system, the domestic water from the Project property will be obtained from the City of Moore. The Contractor shall utilize the water in a conservative manner.

2.09 Cements, Cleaner / Primers and Joint Compounds:
   A. Cement shall be #2200 series Uni-Weld or Rectorseal Cold low temperature plastic pipe cement for use on all sizes and schedules of PVC pipe and fittings. Cement shall be NSSF approved and meet ASTM D2564 requirements.
   B. Cleaner / Primer shall be equal to #8700 United Elchem Hi-Tech Cleaner / Primer.
   C. All threaded connections between metal to metal, PVC to metal and PCV to PVC shall be made using RectorSeal #% slow dry, soft set, thread sealing compound. Thread sealing compound shall not be used on threaded connections between sprinkler and nipple or bubbler and nipple.
   D. All "O" ring gasket and pip spigot ends shall be lubricated using the lubricant recommended or supplied by the pipe manufacturer. If the pip manufacturer does not provide a lubricant for the pip, use IPS Weld-On #787 gasket lube as manufactured by Industrial Polychemical Service.

2.10 Timing Device:
   A. Provide adjustable timing device, 24 hour, and 7 or 14 day clocks to operate any time of day and skip any day in a 7 or 14 day period.
   B. Allow for manual or sem-automatic operation without disturbing preset automatic operation.

Part 3 - Execution

3.01 General:
   A. Installers shall have a minimum of five (5) years of experience locally installing commercial lawn sprinkler equipment and design of lawn sprinkler systems.
   B. Installer shall be responsible for the design of entire system including layout and size of pipes,

valves, controllers, heads, etc.

3.02 Examination:

A. Examine installation areas. Report any conditions that differ from what is present in the Contract Drawings.
   1. Locate all Site Utilities: Locate all site utility systems and perform work in a manner that will also avoid damage.

B. Starting installation constitutes acceptance of conditions or satisfactory for installation of underground irrigation system by Contractor, who shall correct damage and defects or unsatisfactory work at no additional cost.

C. Coordinate with the Landscape Contractor on the location of trees and shrub beds in relationship to the location of sprinkler heads. Adjust plantings and / or sprinkler heads as necessary. Coordinate with Architect.

3.03 Installation:

A. Water Source: Connect to 4” domestic water service located at the east side of the building / classroom addition and as identified on the drawings. The location indicated is schematic. It shall be the Contractor’s responsibility to field verify exact location of water service. Controller to be located as directed by Owner / Architect.
   1. Install water hammer arrester between connection to building main and circuit valves, inside building or in valve box.

B. Trenching:
   1. Sprinkler mains, laterals, and control wires shall be installed in common trenches wherever possible. Wiring shall be separated from pipe a minimum of 6-inches to avoid possibility of current leakages and short circuits. Mains shall be installed a minimum of 18-inches below finished grade. Headers and laterals shall be a minimum of 12-inches below finished grade. Soft, spongy, or otherwise unstable material that will not provide a firm foundation for the pipe shall be removed and replaced with satisfactory fill material as defined therein.
   2. Contractor to provide protective barricades and flagging along all open trenches.

C. Sleeves:
   1. Unless noted otherwise, sleeves shall be installed under all sidewalks, drives and parking

lots. Sleeves shall be Class 200 PVC pipe two (2) sizes larger than the pipe to be sleeved. Sleeves shall be 30-inches below grade. Wiring shall be placed in a separate sleeve from that of the pipe. Ends at sleeves shall be sealed following installation of piping or wiring.

D. Heads:
   1. Heads shall be of the type and make specified. Heads shall be installed with a 4” space between the edge of the head and curbs, walls, driveways, building walls, etc. heads shall be installed in the vertical position and backfilled and compacted to near original density. Contractor shall verify turf area dimension while staking head location. Heads shall be spaced to achieve uniform coverage. Provide adequate flushing of end riser assemblies.

E. Pipe Laying:
   1. Snake pipe in trench at least 1-foot per each 100-feet to allow for expansion and contraction.

F. Backfilling:
   1. After piping has been tested according to paragraph TESTING, trenches shall be cleared of trash and debris. Material for backfilling shall be satisfactory fill material as approved for use on this Project, properly moistened to obtain optimum compaction and compacted by hand or machine tampers to a density equal to the undisturbed adjacent earth or compacted fill.
   2. Install continuous line markers, located directly over buried main lines at 6-8 inches below finish grade during backfilling and topsoil operations.

G. Piping:
   1. General: Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations using approved transition fittings or procedures.
   2. Flushing: When the pipelines are connected and the sprinkler risers in place, but before any heads are installed, the control valves shall be opened and the full head of water used to flush out the system.
   3. Pitch: Mains shall be pitched down not less than 1/4-inch in 10-feet in the direction of drainage valves. Laterals and headers shall be pitched toward the automatic drain valves at not less than 1/8-inch in 10-feet.

4. PVC:
    a. Pipe shall be installed in accordance with manufacturer's instructions or as hereinafter noted.
    b. Solvent cement joints shall be made in accordance with ASTM D2855 and the manufacturer's instructions.
5. Lay pipe on solid subbase, uniformly sloped without humps or depressions.
6. Wall Penetrations:
    1. Pack the opening around the pipe with non-shrink grout. At exterior face, provide backer rod and fill 3/4 deep recess with elastomeric sealant. Repair below grade waterproofing disturbed by this work and make penetration watertight.
7. Restore plant materials disturbed by this work.

H. Valves:
1. Gate valves, remote control valves, and manual drain valves shall be installed with extension valve boxes with tops set flush or not more than 1/2-inch above finished grade. Manual drain valves shall drain into sump pits made of gravel, sufficiently large in size to accommodate the volume of water released. All valves shall be installed as per Drawings and manufacturer’s recommendations and with top of valve not less than 1 inch below bottom of lid valve.
2. Automatic drain valves shall be furnished at all low points on a mainline or within a zone but no closer than 12-inches from the last head. Valves shall be installed at 45 degrees below horizontal into a gravel sump or as recommended by the manufacturer. Sump shall be of sufficient size to accommodate the water released.

I. Control Wiring:
1. Wiring shall be installed a minimum of 12-inches below finished grade to the side of or below piping where possible.
2. Looped slack at valves shall be provided for electrical wiring. Wires shall be snaked in trenches with and expansion loop at 100-foot intervals.
3. Provide a two-wire system to each solenoid valve from the controller.

3.04 Testing:

A. Notification: The Contractor’s Quality Control

Representative will be present at all phases of testing. The Architect shall be notified a minimum of 48 hours prior to any testing.

B. Hydrostatic Testing: Water piping and valves shall be tested psi before piping is covered with earth. Test at a hydrostatic pressure of 100 pounds per square inch without pumping for a period of one hour with an allowable pressure drop of five (5). If hydrostatic pressure cannot be held for a minimum of three hours, make adjustments or replacements and repeat the tests until satisfactory results are achieved. Piping may be tested in sections to expedite work.

3.05 Operation and Maintenance:

A. Installer to provide demonstration on how to operate system. Schedule training at least 7 days prior to session.

B. Provide three (3) copies of O&M Manuals. In each copy, provide "cut sheets" of each material installed, operation manuals of controllers, and any additional materials necessary to provide an inventory of the completed installation.

C. Record Drawings and Controller Chart:

1. Maintain a complete set of irrigation Record Drawings.
2. Prepare a controller chart showing:
   a. Location of all sections, valves, lateral lines, and routes of control wires.
   b. Identify all valves as to size, station, number, and type of irrigation.
   c. Provide chart as a black-line print to show area of coverage for each station. Color copies are recommended.
   d. Locate chart inside controller door. Seal chart between two pieces of laminate.
   e. Complete chart and receive approval prior to final inspection of irrigation system.

D. Final Testing and Acceptance:

1. Final testing shall show proper operation of all components and actual measured application rates at representative and selected locations. All irrigated areas shall have 100% coverage, add extra bubblers, piping and accessories as required to achieve 100% coverage.
2. Upon final acceptance of the project, the Owner will assume responsibility for maintenance of the irrigation system.
   a. Acceptance of the underground irrigation

system is based on the Contractor furnishing a complete As-Built set of plans and an Operations and Maintenance Manual acceptable to the Architect / Owner.

E. Extra Materials:
   1. Provide the following extra components:
      a. Two (2) sprinkler heads of each type and size.
      b. Two (2) valve keys for manual valves.
      c. Two (2) valve box keys.
      d. Two (2) keys for valve markers.
   2. Two (2) wrenches for each type of head core and for removing and installing each type of head.

End of Section

DIVISION 2 - SITE WORK

SECTION 02900 - TURF ESTABLISHMENT

Part 1 - GENERAL

1.01 Summary:

A. This section generally describes the work, equipment, and materials required to furnish and landscape the site. The Contractor shall provide all necessary labor, equipment and materials to construct and complete site work landscaping. All work shall be completed in conformance with the recommendations of plant material suppliers.

B. As a minimum, the Contractor must be able to provide the following materials and services:

1. Supply and grade of fill material
2. Environmentally approved control/elimination of weeds/grasses.

1.02 References:

A. Drawings and general provisions of the Project Manual and Contract, including General and Supplementary Conditions and Division I Specification sections, apply to Work of this Section.

1.03 Submittals:

A. Architect approval is required. The following shall be provided:

1. Pesticide and Herbicide Treatment Plan, giving proposed sequence of pesticide and herbicide treatment work, before work is started. The pesticide and herbicide trade name, chemical composition, formulation, concentration, application rate of active ingredients and methods of application for all materials furnished, and the name and state license number of the state certified applicator shall be included.
2. Certificates of compliance certifying that materials meet the requirements specified, prior to the delivery of materials. Reports for the following materials shall be included:
   a. Fertilizer: For chemical analysis and composition percent.
   b. Pesticide and Herbicide Material: For EPA registration number and registered uses.

1.04 Quality Assurance:

A. All plant materials shall be guaranteed for one (1) year, following Architect=s acceptance of the project.

B. The Contractor shall maintain the project by weeding, watering, and other tasks as required, through final acceptance of the project by the Owner. Weeds, trimmings, etc. shall be removed from the site on the day work is performed and the area cleaned. Contractor shall immediately replace any and all defective

components or dead or dying plant materials.

C. The Architect shall inspect all planting materials upon delivery to the site and reserves the right to reject any or all materials which do not conform to the intent of this specification.

1.05 Delivery, Storage and Handling:

A. Pesticide and herbicide materials shall be delivered to the site in the original unopened containers bearing legible labels indicating the Environmental Protection Agency (EPA) registration numbers and the registered uses.

B. Sod not installed on the day of arrival at the site shall be stored and protected in areas designated by the Architect. Sod shall be protected from exposure to wind and shall be shaded from the sun. Covering that will allow air to circulate and prevent internal heat from building up shall be provided. All sod shall be kept in a moist condition by watering with a fine mist spray until planted.

C. Soil amendments shall be stored in dry locations away from contaminants. Pesticide and herbicide materials shall not be stored with other landscape materials. Storage of materials shall be in areas designated or as approved by the Architect.

D. Care shall be taken to avoid injury to sod. Materials shall not be dropped from vehicles.

Part 2 - Products

2.01 Materials:

A. Plants:

1. Turf grass shall be Bermuda sod. Sod shall be freshly cut (no more than 5 days). Water all areas to receive sod 1/4" less than 24 hours prior to installation of new sod. Sod all disturbed and exposed soil within the project limits as indicated on the Drawings.
2. Substitutions will not be permitted without written request from the Contractor for approval by the Architect.
3. Sod shall be grown under climatic conditions similar to those in the locality of the project.

2.02 Topsoil:

A. Acceptable topsoil includes selectively excavated material that is representative of soils in the vicinity that produces growth of grass typical of the project area. Topsoil should be reasonably free from underlying subsoil, clay lumps, objectionable weeds, litter, brush, matted roots, toxic substances or any material that might be harmful to plant growth or be a hindrance to grading, planting, or maintenance operations. Topsoil shall not contain more than five percent

by volume of stones, stumps or other objects larger than 3/4 inch in any dimension.

2.03 Fertilizer:

A. The commercial grade of fertilizer shall be suitable for the locations and season approved by the Architect. The P-N-K content shall be determined on the basis of soil conditions and the plants involved.

B. Prepackaged fertilizer delivered to the site shall be packaged in new, sealed, clean containers which bear a label fully describing the contents, the chemical analysis of each nutrient, the fertilizer grade, the net bulk, and the brand name and address of the manufacturer. Bulk fertilizer delivered to the site shall be accompanied with certification describing the contents, the chemical analysis of each nutrient, the fertilizer grade, the net bulk, and the brand name and address of the manufacturer. No fertilizer which becomes caked or otherwise damaged will be accepted.

2.04 Water:

A. Water shall not contain elements toxic to plant life.

B. The Contractor is responsible for ensuring that new lawns are adequately watered at all times.

C. During prolonged periods of drought, watering guidelines established by local water district shall apply.

Part 3 - Execution

3.01 Examination:

A. The Architect shall verify the finished grades are as indicated on drawings, and the placing of topsoil and smooth grading has been completed.

B. The location of underground utilities and facilities shall be verified. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

3.02 Site Preparation:

A. Prior to placing topsoil, the ground surface shall be cleared of all brush, snags, and rubbish.

B. Previously constructed grades shall be repaired if necessary so that areas to be topsoiled conform to the final grades upon completion of topsoil placement.

C. The topsoil shall be uniformly distributed on the designated areas and evenly spread to a minimum thickness of 6 inches. The spreading shall be performed in such a manner that planting can proceed with little additional soil preparation or tillage. The surface resulting from topsoiling shall meet the finish surface requirements as specified. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry,

or in a condition otherwise detrimental to proper grading or the proposed planting.

D. All topsoiled areas covered by the project shall be uniformly smooth graded. The finished surface shall be reasonably smooth and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from either blade-grader or scraper operations. The finished surface shall be free of depressed areas where water would pond.

3.03 Application of Pesticide Material:

A. When pesticide becomes necessary to remove a disease or pest, a state-certified applicator shall apply required pesticide in accordance with State EPA label restrictions and recommendations. Hydraulic equipment shall be provided for the liquid application of pesticides with a leak-proof tank, positive agitation methods, controlled application pressure and metering gauges. A pesticide treatment plan shall be provided to the Architect as specified in paragraph SUBMITTALS.

3.04 Restoration and Clean Up:

A. Planting areas, pavements and facilities that have been damaged from the planting operation shall be restored to original condition at the Contractor's expense.

B. Excess and waste material from the planting operation shall be removed and disposed of off the site. Adjacent paved areas shall be cleared.

End of Section

DIVISION 2 – SITE WORK

SECTION 02910 – TEMPORARY EROSION CONTROL

Part 1 – General

1.01 Work Included: The work under this section of the Specifications shall include all temporary erosion control measures including, but not necessarily limited to, rapid stabilization, rock entrance, silt fence, bale checks, bio rolls, and interim mulch as may be necessary to control soil erosion and sedimentation. The work shall include furnishing all materials, labor and equipment required for the construction and maintenance of erosion and sediment control devices as shown on the Drawings or as directed by the Architect. The work shall also include all inspections and reports as required by the storm water discharge permit for construction activities.

1.02 Reference Specifications:

A. The erosion prevention requirements of the City of Moore shall be considered as a part of this Specification.

B. All testing required by the Jurisdiction Having Authority shall be performed by the independent testing laboratory retained by the Contractor. The costs of said testing shall be borne by the Contractor.

1.03 Stormwater Pollution Prevention – General Permit: if a Permit is required by the local Jurisdiction Having Authority, it shall be obtained from said authority and all fees and/or costs shall be paid by the Contractor.

A. The Contractor will furnish a copy of the completed application package and General Permit to the Architect.

B. The back and side lot ditches shall be sodded immediately after they have been graded and top soil spread.

Part 2 – Products

2.01 Erosion Control Blankets: Erosion control blankets shall conform to applicable requirements.

2.02 Silt Fence: refer to the Drawings.

A. The geotextile fabric shall be free of flaws such as tears or other defects. Any geotextile fabric which becomes damaged shall be replaced. The geotextile fabric shall meet or exceed the following requirements:

1. Grab Strength (ASTM D 4632)	100 lbs.
2. Apparent Opening Size (ASTM D 4751)	20 - 70 sieve range
3. Width	36 inches

SECTION 02910 – TEMPORARY EROSION CONTROL

Part 3 - Execution

3.01 General:

A. Temporary erosion control measures such as erosion control blankets, bio rolls, rock entrance, and silt fences shall be coordinated with the site work and turf establishment. No site work will be permitted until ALL necessary temporary erosion control measures are completed and in place in order to prevent excessive soil erosion and subsequent siltation from entering wetlands, streams or storm sewers. The construction of erosion control measures shall not relieve the Contractor of the responsibility for preventing or minimizing the potential for erosion or siltation. The Contractor shall be responsible for all damages and clean up and the costs therefore, resulting from erosion of the soils and any siltation which may occur, regardless of the temporary erosion control measures taken.

B. The alignment and location of erosion control measures shall be as show on the Drawings or as directed by the Architect. Minimum measures are shown on the Drawings. The Contractor shall incorporate further measures into the work as the Contractor's progress may dictate. Inspections of the temporary erosion control measures and reports thereof, shall be made by the Contractor in accordance with the storm water discharge permit for construction activities.

C. Structural practices:

1. Perimeter Ditches – Perimeter ditches will be installed to collect runoff from the disturbed area and direct runoff to the sedimentation basin.

D. Rapid stabilization shall be used in the following areas as well as the areas shown on the Plans.

1. Disturbed areas around culvert inlets and streams.
2. Ditches draining from the construction sites.
3. Disturbed slopes near storm drain inlets.

3.02 Timing of Controls/Measures: Any ditches and stabilized construction entrances shall be constructed prior to grading of any other portions of the site. Areas where construction activity temporarily ceases for more than 21 days will be stabilized with a temporary seed and mulch within 14 days of the last disturbance. Once construction activity ceases permanently in an area, that area will be stabilized with permanent sod turf.

3.03 Removal of Temporary Erosion Control: Temporary erosion control devices shall remain in place until the permanent measures (turf establishment) have become established as

determined by the Architect. All areas disturbed by the removal of temporary erosion control measures shall receive the same turf establishment as the areas adjacent thereto.

3.04 Installation Requirements:

A. Bio Rolls shall be installed as required to reduce erosion.

B. Silt Fence shall be constructed on 2 x 2 wood posts that are spaced no more than 6 feet and embedded no less than 2.0 feet. The geotextile fabric shall be secured to the upstream face of the posts. The geotextile fabric shall be embedded in an anchor trench along the upstream side of the silt fence. The anchor trench shall be 12 inches deep by 12 inches wide and shall extend the full length of the silt fence. The geotextile fabric shall line both sides and the bottom of the anchor trench. The anchor trench shall be backfilled with the excavated material, which shall be firmly compacted into place.

C. Rate of slurry application shall be variable depending on surface roughness, slope configuration and degree of undulation but it is expected that 6 M gallons per acre. This rate is equivalent to applying Type 6 Hydraulic Soil Stabilizer at 2100 pounds per acre. Amount of material applied shall be such to obtain 100% soil surface coverage. In inaccessible areas, the mix may be pumped through a hose. To obtain coverage, two (2) passes may be necessary. In inaccessible areas, the mix may be pumped through a hose.

3.05 Maintenance:

A. It shall be the Contractor's responsibility to maintain all erosion control measures and to inspect same after each rainfall event. All displaced bio rolls shall be replaced and silt fences shall be repaired where sagging or otherwise damaged. The Contractor shall review the temporary erosion control measures and make revisions as necessary in order to minimize damage due to future rainfalls. All costs of temporary erosion control shall be considered incidental and the responsibility of the Contractor.

B.The rock entrances may need occasional maintenance to prevent the tracking of mud onto paved roads. This may require periodic top-dressing with additional rock or removal and reinstallation of the entrances. The cost of maintenance of rock entrances shall be the responsibility of the Contractor.

3.06 Waste Disposal:

A. Waste Materials: All waste materials will be disposed of as described in the "Construction Storm Water Pollution Prevention Plan".

3.07 Offset Vehicle Tracking: One (1) stabilized construction entrances shall be constructed to help reduce vehicle tracking of sediments. The paved parking lot adjacent to the site entrance shall be swept as needed to remove any excess mud, dirt or rock tracked from the site. Dump trucks hauling material from the construction site shall be covered with a tarp.

3.08 Maintenance/Inspection Procedures:

A. Erosion and Sediment Control Inspection and Maintenance Practices:

1. All control measures will be inspected at least once each week and following any storm event of 0.5 inches or greater.
2. All measures will be maintained in good working order; if a repair is necessary, it will be initiated within 24 hours of report.
3. Build up sediment will be removed from silt fence when it has reached one-third the height of the fence.
4. Silt fence will be inspected for depth of sediment, tears, to see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground.
5. Ditches will be inspected and any erosion promptly repaired.

B. Non-Storm Water Discharges: All non-storm water discharges will be directed to a location selected by the Contractor and approved by the Architect. It is expected that the following non-storm water discharges will occur from the site during the construction period:

1. Water from water line flushing.
2. Pavement wash waters (where no spills or leaks of toxic or hazardous materials have occurred).
3. Uncontaminated groundwater (from dewatering excavation).

3.09 Spill Prevention:

A. Material Management Practices.

The following good housekeeping practices shall be followed onsite during the construction project.

1. Good Housekeeping:

The following good housekeeping practices shall be followed onsite during the construction project:

a. An effort shall be made to store only enough product required to do the job.
b. All materials stored onsite shall be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof or other enclosure.

c. Products shall be kept in their original containers with the original manufacture's label.
d. Substances shall not be mixed with one another unless recommended by the manufacturer.
e. Whenever possible, all of a product shall be used up before disposing of the container.
f. Manufacturers' recommendations for proper use and disposal shall be followed.
g. The site superintendent shall inspect daily to ensure proper use and disposal of materials onsite.

2. Hazardous Products: These practices are used to reduce the risks associated with hazardous materials.
   a. Products shall be kept in original containers unless they are not re-sealable.
   b. Original labels and material safety data shall be retained; they contain important product information.
   c. If surplus product must be disposed of, manufactures' or Local and State recommended methods for proper disposal shall be followed.

B. Product Specific Practices: The following project specific practices shall be followed onsite:

1. Petroleum Products:
   All onsite vehicles shall be monitored for leaks and receive regular preventative maintenance to reduce the change of leakage. Petroleum products shall be stored in tightly sealed containers which are clearly labeled. Any asphalt substances used onsite shall be applied according to the manufacturer's recommendations.
2. Fertilizers:
   Fertilizers used shall be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer shall be worked into the soil to limit exposure to storm water. Storage shall be in a covered shed. The contents of any partially used bags of fertilizer shall be transferred to a sealable plastic bin to avoid spills.
3. Paints:
   All containers shall be tightly sealed and stored when not required for use. Excess paint shall not be discharged to the storm sewer system but shall be properly disposed of according to manufactures' instructions or State and Local regulations.

4. Concrete Trucks:
   Concrete trucks shall not be allowed to wash out or discharge surplus concrete or drum wash water on the site.

C. Spill Control Practices:
In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices shall be followed for spill prevention and cleanup:

1. Manufacturer's recommended methods for spill cleanup shall be clearly posted and site personnel will be made aware of the procedures and the location of the information and cleanup supplies.
2. Materials and equipment necessary for spill cleanup shall be kept in the material storage area onsite. Equipment and materials shall include but not be limited to brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust, and plastic and metal trash containers specifically for this purpose.
3. All spills shall be cleaned up immediately after discovery.
4. The spill area shall be kept well ventilated and personnel shall wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
5. Spills of toxic or hazardous material shall be reported to the appropriate State or Local government agency, regardless of the size.
6. The spill prevention plan shall be adjusted to include measures to prevent this type of spill from reoccurring and how to clean up the spill if there is another one. A description of the spill, what caused it, and the cleanup measures shall also be included.

End of Section

DIVISION 2 - SITE WORK

SECTION 02920 - LANDSCAPE GRADING

Part 1 -General

1.01 Summary:
- A. This section describes the labor, materials and installation requirements necessary to complete the fine grading, incidental grading, and related items as indicated or specified.

1.02 Site Conditions:
- A. Protect landscaping and other features remaining as final work.
- B. Protect any existing structures, roads, sidewalks, paving and curbs, or other features pertinent to the site in this project.

Part 2 - Products NOT USED

Part 3 - Execution

3.01 Examination:
- A. The areas to be graded will be free of waste or debris developed by other trades.
- B. Contractor shall field verify all dimensions and/or layout prior to starting work.

3.02 Preparation:
- A. Prepare site by applying Round Up, or approved equal, as per label directions to weed growth on site.
  1. Scarify planting areas to a minimum depth of six (6) inches and thoroughly water to settle all soil.

3.03 Grading:
- A. Contractor shall grade all planting areas, swales or other areas as noted on drawings.
  1. Contractor shall provide incidental grading of all areas adjacent to curbs and sidewalks. Provide a finish grade one (1") inch below curbs or sidewalks.
  2. Contractor shall fine grade turf areas, eliminating rough or low areas to ensure positive drainage.
  3. Any other areas not covered specifically above shall be graded to leave a generally smooth appearance conforming to standard landscape practices defined as: The final surface shall be raked; all objectionable materials, trash, brush, weeds, and stones larger than one inch shall be removed from the site and disposed of properly off base.
  4. When sod is being installed, the appropriate sub-grade shall be graded prior to the installation of such materials. See applicable specifications, in any, for additional requirements.

End of Section

DIVISION 3 – CONCRETE

SECTION 03300 – CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 Section Includes
- A. Concrete formwork.
- B. Slabs on grade.
- C. Concrete foundation walls and retaining walls.
- D. Concrete reinforcement.
- E. Joint devices associated with concrete work.
- F. Miscellaneous concrete elements, including equipment pads and equipment pits.
- G. Concrete curing.

1.02 Related Requirements
- A. See Section 01 3000 – Administrative Requirements, for submittal procedures.
- B. Section 07 9200 – Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints, construction joints and isolation joints in slabs.

1.03 Reference Standards
- A. For all reference standards listed below, comply with the version year in the governing building code adopted by the Authority Having Jurisdiction. For those reference standards that are not directly referenced by the building code, use the latest edition unless noted otherwise.
- B. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
- C. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- D. ACI 301 – Specifications for Structural Concrete.
- E. ACI 302.1R – Guide to Concrete Floor and Slab Construction.
- F. ACI 302.2R – Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
- G. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- H. ACI 305R – Guide to Hot Weather Concreting.
- I. ACI 305.1 – Specification for Hot Weather Concreting.
- J. ACI 306R – Guide to Cold Weather Concreting.
- K. ACI 308R – Guide to External Curing of Concrete.
- L. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
- M. ACI 347R – Guide to Formwork for Concrete.
- N. ACI SP-66 – ACI Detailing Manual.
- O. ASTM A615/A615M – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- P. ASTM A706/A706M – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.

Q. ASTM A1064/A1064M – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
R. ASTM C33/C33M – Standard Specification for Concrete Aggregates.
S. ASTM C39/C39M – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
T. ASTM C94/C94M – Standard Specification for Ready-Mixed Concrete.
U. ASTM C143/C143M – Standard Test Method for Slump of Hydraulic-Cement Concrete.
V. ASTM C150/C150M – Standard Specification for Portland Cement.
W. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete.
X. ASTM C173/C173M – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
Y. ASTM C260/C260M – Standard Specification for Air-Entraining Admixtures for Concrete.
Z. ASTM C494/C494M – Standard Specification for Chemical Admixtures for Concrete.
AA. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
AB. ASTM C1064/C1064M – Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
AC. ASTM C1107/C1107M – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
AD. ASTM C1602/C1602M – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
AE. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
AF. ASTM D2103 – Standard Specification for Polyethylene Film and Sheeting.
AG. ASTM E1745 – Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
AH. CRSI (DA4) – Manual of Standard Practice.
AI. ICC (IBC)-2015 – International Building Code.

1.04 Definitions

A. Cold Weather: A period when for more than three successive days the average daily outdoor temperature drops below 40 F. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. When temperatures above 50 F occur during more than half of any 24 hr duration, the period shall no longer be regarded as cold weather.

B. Hot Weather: Hot weather is any combination of the following conditions that tends to impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and rate of cement hydration, or otherwise causing detrimental results:
   1. High ambient temperature
   2. High concrete temperature
   3. Low relative humidity
   4. Wind speed
   5. Solar radiation

1.05 Submittals

A. See Section 01 3000 – Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

C. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 – Concrete Mixtures.
   2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 26 – Concrete Documents and Inspection.

D. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

E. Test Reports: Submit report for each test or series of tests specified.

F. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

G. Formwork Design Submittal: As required by authorities having jurisdiction.

H. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

I. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 Quality Assurance

A. Perform work of this section in accordance with ACI 301 and ACI 318.

B. Follow recommendations of ACI 305R when concreting during hot weather.

C. Follow recommendations of ACI 306R when concreting during cold weather.

D. For slabs required to include moisture vapor reducing admixture (MVRA), do not proceed with placement unless manufacturer's representative is present for placement as required by the manufacturer's warranty.

1.07 Warranty

A. See Section 01 3000 – Administrative Requirements, for submittal procedures.

B. See Section 01 7800 – Closeout Submittals, for additional warranty requirements.

C. Slabs with Moisture Vapor Reducing Admixture (MVRA): Provide warranty to cover cost of flooring failures due to moisture migration from slabs for life of the concrete.

1. Include cost of repair or removal of failed flooring, placement of topical moisture remediation system, and replacement of flooring with comparable flooring system.
2. Provide warranty by manufacturer of MVRA matching terms of flooring adhesive or primer manufacturer's material defect warranty.

PART 2 PRODUCTS

2.01 Formwork

A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.

B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.

1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
2. Earth Cuts: Do not use earth cuts as forms for vertical surfaces of trenched footings unless expressly allowed in the General Notes in the structural drawings. Natural rock formations that maintain a stable vertical edge may be used as side forms for below-grade concrete.
3. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
4. Form Ties: Cone snap type that will leave no metal within the clear cover zone of the concrete surface as specified in the Minimum Concrete Cover for Cast-in-Place Non-Prestressed Members table included in the General Notes of the structural drawings.

2.02 Reinforcement Materials

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished, unless otherwise indicated.

B. Reinforcing Steel: ASTM A706/A706M, deformed low-alloy steel bars, weldable.
   1. Unfinished.

C. Reinforcement Accessories:
   1. Joint Dowel Bars: ASTM A615/A615M, Grade 60 (60,000 psi) plain-steel bars, cut true to length with ends square and free of burrs.
   2. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
   3. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
      a. Continuous slab bolsters shall be used to support the bottom reinforcing bars of all reinforced slabs-on-grade.
   4. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement of reinforcing steel within 1-1/2 inches of weathering surfaces and for concrete surfaces that will be exposed to view.

D. Fabrication of Reinforcing:
   1. Fabricate concrete reinforcing in accordance with CRSI (DA4) – Manual of Standard Practice.
   2. Welding of reinforcement is permitted only with the specific approval of Architect/Engineer. Perform welding in accordance with AWS D1.4/D1.4M.
   3. Locate reinforcing splices not indicated on drawings at point of minimum stress.

2.03 Concrete Materials

A. Cement: ASTM C150/C150M, Type I – Normal Portland type.
   1. Acquire cement for entire project from same source.

B. Fine and Coarse Aggregates: ASTM C33/C33M.
   1. Acquire aggregates for entire project from same source.

C. Fly Ash: ASTM C618, Class C or F.

D. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 Admixtures

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Air Entrainment Admixture: ASTM C260/C260M.

C. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

D. Water Reducing Admixture: ASTM C494/C494M Type A.

E. Moisture Vapor Reducing Admixture (MVRA): Liquid, inorganic admixture free of volatile organic compounds (VOCs) and formulated to close capillary systems formed during curing to reduce moisture vapor emission and transmission with no adverse effect on concrete properties or finish flooring.
   1. Provide admixture in slabs to receive adhesively applied flooring.
   2. Manufacturers:
      a. Barrier One, Inc; Barrier One Moisture Vapor Reduction Admixture: www.barrierone.com/#sle.
      b. Substitutions: Substitutions shall comply with the use of concrete staining/dye products. See Section 01 6000 – Product Requirements.

2.05 Accessory Materials

A. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with ASTM C1107/C1107M.

2.06 Bonding And Jointing Products

A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.
B. Epoxy Bonding System:
   1. Complying with ASTM C881/C881M and of Type required for specific application.
C. Waterstops: Bentonite and butyl rubber, complying with NSF 61 and NSF 372.
D. Slab Isolation Joint Filler: 1/2 inch (13 mm) thick, height equal to slab thickness.
   1. Material: ASTM D1751, cellulose fiber.

2.07 Evaporation Retarders

A. Evaporation Retarder: Liquid thin film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement. These products provide a protective film shield over plastic concrete, dissipate as soon as the concrete is no longer plastic, and are not curing products.
   1. Manufacturers:
      a. Euclid Chemical Company ; EUCOBAR: www.euclidchemical.com/#sle.
      b. SpecChem, LLC; SpecFilm Concentrate or SpecFilm: www.specchemllc.com/#sle.
      c. W. R. Meadows, Inc ; Evapre or Evapre-RTU: www.wrmeadows.com/#sle.
      d. Substitutions: See Section 01 6000 – Product Requirements.

2.08 Liquid Floor Treatments

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ChemMasters; Chemisil Plus.
   b. ChemTec Int'l; ChemTec One.
   c. Conspec by Dayton Superior; Intraseal.
   d. Curecrete Distribution Inc.; Ashford Formula.
   e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
   f. Edoco by Dayton Superior; Titan Hard.
   g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
   h. Kaufman Products, Inc.; SureHard.
   i. L&M Construction Chemicals, Inc.; Seal Hard.
   j. Meadows, W. R., Inc.; LIQUI-HARD.
   k. Metalcrete Industries; Floorsaver.
   l. Nox-Crete Products Group; Duro-Nox.
   m. Symons by Dayton Superior; Buff Hard.
   n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
   o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.

2.09 Curing Materials

A. Moisture-Retaining Sheet: ASTM C171.

1. Polyethylene film, white opaque, minimum nominal thickness of 4 mil, 0.004 inch.
2. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.

B. Polyethylene Film: ASTM D2103, 4 mil, 0.004 inch thick, clear.

C. Water: Potable, not detrimental to concrete.

2.10 Concrete Mix Design

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.

1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

D. Normal Weight Concrete: Refer Structural General Notes for mix requirements for various classes of concrete.

2.11 Mixing

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

B. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 Examination

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

3.02 Preparation

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent according to bonding agent manufacturer's instructions.

1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
2. Use latex bonding agent only for non-load-bearing applications.

E. Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.

F. In locations where new concrete is doweled to existing work, drill holes in existing concrete, clean out drilled holes, inject the adhesive indicated on drawings and/or General Notes, and insert steel dowels, all in accordance with adhesive manufacturer's installation instructions.

G. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade in accordance with manufacturer's instructions, ASTM E1643, ASTM F710 and ACI 302.2R.
   1. Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.
   2. Lap vapor retarder sheet over footings and seal to previously placed concrete foundations.
   3. Lap joints minimum 6 inches (150 mm).
   4. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
   5. No penetration of vapor retarder is allowed except for reinforcing steel and permanent utilities.
   6. Repair damaged vapor retarder before covering with other materials.
   7. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.

3.03 Installing Reinforcement And Other Embedded Items

A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

C. Verify that anchors, seats, plates, reinforcement, waterstops and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 Placing Concrete

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Notify Architect not less than 48 hours prior to commencement of placement operations.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

G. Finish slab-on-grade and shored elevated floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 Slab Jointing

A. Locate and install joints as indicated on drawings and Slab-On-Grade Schedule or as submitted by Contractor and approved by structural engineer.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler, total height equal to thickness of slab, set flush with top of slab.

1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.

D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.

E. Saw Cut Contraction Joints: Saw cut joints shall be installed with early-entry dry-cut saw before concrete begins to cool, within 1 to 4 hours after completing the slab finishing operations; commence in approximately 1 hours in hot weather or approximately 4 hours in cold weather. Use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab. Refer to Slab-On-Grade Schedule in drawings for additional requirements.

3.06 Floor Flatness And Levelness Tolerances

A. An independent testing agency, as specified in Section 01 4000, will inspect finished slabs for compliance with specified tolerances.

B. Maximum Variation of Surface Flatness:

1. Exposed Concrete Floors: 1/4 inch in 10 feet.
2. Under Seamless Resilient Flooring: 1/4 inch in 10 feet.
3. Under Carpeting: 1/4 inch in 10 feet.

C. Correct the slab surface if surface variations exceed specified tolerances.

D. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 Concrete Finishing

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
   1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.

D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
   1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI 302.1R; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
   2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
   3. Decorative Exposed Surfaces: Trowel as described in ACI 302.1R; take measures necessary to avoid black-burnish marks; decorative exposed surfaces include surfaces to be stained or dyed, pigmented concrete, surfaces to receive liquid hardeners, surfaces to receive dry-shake hardeners, surfaces to be polished, and all other exposed slab surfaces.
   4. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.

E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal (approximately 1/8 inch per foot).

3.08 Curing And Protection

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Uniformly apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss due to evaporation approaching 0.2 lb/sq.ft./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. A methodology for calculating the moisture loss due to evaporation is provided in ACI 305.1.

C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven (7) days.

D. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

E. Surfaces Not in Contact with Forms:

1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than seven (7) days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
    a. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for seven (7) days.
    b. Spraying: Spray water over floor slab areas and maintain wet.
    c. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
2. Final Curing: The surface shall be protected against rapid moisture loss upon the termination of initial curing by replacing wet burlap or similar coverings with plastic sheets until the surface has dried under the sheets.
    a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.

3.09 Liquid Floor Treatments

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than 28 days old.
    a. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.10 Field Quality Control

A. An independent testing agency will perform Special Inspections and field quality control tests as required by

Chapter 17 of ICC (IBC)-2015. The testing outlined below includes some, but not all, of the testing and observations required to meet the Special Inspection provisions of the building code. Refer to the following parts of the structural drawings for additional Special Inspection requirements:

1. Statement of Special Inspection Notes
2. Table 1705.3 titled "Required Special Inspections and Tests of Concrete Construction"

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit approved mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure four concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed each day.

F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

H. Air Content: ASTM C173/C173M, one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

I. Concrete Temperature: ASTM C1064/C1064M, 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.

J. Slab Testing: Cooperate with manufacturer of specified moisture vapor reducing admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.

3.11 Defective Concrete

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.12 Protection

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

END OF SECTION

DIVISION 4 – MASONRY

SECTION 04810 – UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.01 Related Documents:
- A. Drawings and general provisions of the Contract, including Special Conditions and applicable Specification Sections, apply to this Section.

1.02 Summary
- A. Section Includes:
  1. Concrete block.
  2. Clay facing brick.
  3. Mortar and grout.
  4. Reinforcement and anchorage.
  5. Lintels.
  6. Accessories.

1.03 Related Sections:
- A. Section 05500 - Metal Fabrications: Loose steel lintels and fabricated steel items.
- B. Section 07620 – Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- C. Section 07900 - Joint Sealers: Backing rod and sealant at control and expansion joints.

1.04 References:
- A. ACI 530/ASCE 5/TMS 402 - Building Code Requirements for Masonry Structures; American Concrete Institute International; 2008.
- B. ACI 530.1/ASCE 6/TMS 602 - Specification For Masonry Structures; American Concrete Institute International; 2008.
- C. ASTM A 82/A 82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2005a.
- D. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
- E. ASTM C 129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2006.
- F. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar; 2004.
- G. ASTM C 150 - Standard Specification for Portland Cement; 2005.
- H. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006.
  ASTM C 270 - Standard Specification for Mortar for Unit Masonry; 2007.
- I. ASTM C 404 - Standard Specification for Aggregates for Masonry Grout; 2006.

J. ASTM C 476 - Standard Specification for Grout for Masonry; 2002.

1.05 Submittals:

A. Product Data: Provide data for masonry units, mortar, and masonry accessories.

B. Samples: Submit 10 samples of facing brick units to illustrate color, texture, and extremes of color range.

C. Construct sample wall with ALL materials to be supplied including proposed brick veneer and mortar. Architect shall view the finished sample wall and comment / approve prior to proceeding with work on new building.

1.06 Quality Assurance:

A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents

1.07 Pre-Installation Meeting:

A. Convene one week before starting work of this section.

1.08 Delivery, Storage, and Handling:

A. Deliver, handle, and store masonry materials by means that will prevent mechanical damage and contamination by other materials.

1.09 Project Conditions:

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

B. 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 ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

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

PART 2 - PRODUCTS

2.01 Concrete Masonry Units:

A. Type: Lightweight (Standard Modular Sizes).

B. Quality: ASTM C-90, Type 1, Grade N, steam cured for a

minimum of 8 hours at 350 degrees Fahrenheit under 150 psi. CMU shall be made by the Johnson CO 2 or Autoclave method. Other methods shall have approval by the Architect.

C. Face Dimension: As indicated on the drawings.

D. Thickness: As indicated on the drawings.

E. Shapes: Provide all shapes as shown on the drawings or others as required.

F. Units shall be uniform in all dimensions and texture, straight and free from cracks, spalls and other defects.

2.02 Face Brick (Veneer):

A. Type and Finish: Velour Modular Brick.

B. Quality: ASTM C-216, Type FBS.

C. Size: Nominal 4” x 2 2/3” x 8” or as directed / approved by Architect.

D. Units shall be uniform in all dimensions and texture, straight and free from cracks, spalls and other defects.

E. Color: refer to Color Schedule and confirm with Architect.

2.03 Mortar and Grout Materials:

A. Portland Cement: ASTM C 150, Type I.

1. Hydrated Lime: ASTM C 207, Type S.
2. Mortar Aggregate: ASTM C 144.
3. Grout Aggregate: ASTM C 404.

B. Water: Clean and potable.

2.04 Reinforcement and Anchorage:

A. Manufacturers of Joint Reinforcement and Anchors:

1. Dur-O-Wal: www.dur-o-wal.com.
2. Hohmann & Barnard, Inc: www.h-b.com.
3. Masonry Reinforcing Corporation of America: www.wirebond.com.
4. Substitutions: as approved by Architect / Engineer.

B. Reinforcing Steel: ASTM A 615/A 615M Grade 40 (280) deformed billet bars; galvanized.

C. Single Wythe Joint Reinforcement: Truss type; ASTM A 82/A 82M steel wire, mill galvanized to ASTM A 641/A 641M, Class 3; 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage on each exposure.

D. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage from masonry face.

E. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.

1. Anchor plates: Not less than 0.075 inch (1.91 mm) thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
2. Wire ties: Triangular shape, 0.1875 inch (4.75 mm) thick.
3. Vertical adjustment: Not less than 3-1/2 inches (89 mm).

2.05 Flashings:

A. Metal Flashing Materials: Galvanized Steel / Prefinished Metal as specified in Section 07600.

2.06 Accessories:

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.

B. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35%; formulated from neoprene, urethane or PVC.

C. Bond Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type 1 (No. 15 asphalt felt).

D. Weeps: Free-draining mesh made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe.

1. Manufacturers:
   a. Mortar Net USA, Ltd; Product – Mortar Net Weep Vents: www.martarnet.com
   b. Substitutions: as approved by Architect / Engineer.

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

2.07 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. Limit cementitious materials in mortar to portland cement and lime.

B. Mortar for Unit Masonry: ASTM C 270, using the Proportion Specification.

1. All masonry: Type S.
   a. Portland Cement Mixture: One part Grey Portland Cement; 1/4 to 1/2 part lime; sand, not less than 2-1/4 and not more than three times the sum of

the volumes of cement and lime used, measured in damp, loose conditions.

b. Colors at exterior face brick to be selected by Architect to match colors noted in the Color Schedule.

C. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
   2. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measure according to ASTM C 143/C 143M.

D. Mortar Mixing
   1. All mortars shall be machine mixed in equipment that is free of dirt, oil or grease and which is thoroughly cleaned and rinsed after each day's use. Mix no more mortar than can be used before setting takes place.
   2. Mortars shall be mixed placing all dry ingredients in the mixer first and mixing until uniform in color. Then mixed for 3 to 5 minutes with the maximum amount of water to provide workable consistency.
   3. No add-mixtures shall be used at any time in the mortar on this project, unless approved in writing by the Engineer.
   4. A waterproofing additive will be used in the mortar for brick.
   5. Construct one or two wooden boxes 12"x12"x6" deep and use them to measure the sand required in a batch. Add the cement or lime by the bag. Then add water, measuring by pail. When the desired consistency of mix is determined, mark the level of the mortar in the mixing drum. Use that as the mark for later batches when sand will be added by the shovel full. Repeat the measuring process halfway through the day or whenever the inspector requests it.
   6. Testing: General Contractor will observe a minimum of three (3) observed mixing sessions to verify that the quantities are being mixed as described in the proportions paragraph for Type "S" mortar.

PART 3 - EXECUTION

3.01 Examination:

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

B. Verify that related items provided under other sections are

properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 Erection:

A. Construction Requirements (Masonry Being Worked On)
   1. Air Temperature 40 F to 32 F: Heat sand or mixing water to minimum of 70 F and maximum of 160 F.
   2. Air Temperature 32 F to 25 F: Heat sand and mixing water to minimum of 70 F and maximum of 160 F.
   3. Air Temperature 25 F to 20 F: Heat sand and mixing water to minimum of 70 F and maximum of 160 F. Use salamanders or other sources of heat on both sides of walls under construction. Employ windbreaks when wind is in excess of 15 mph.
   4. Air Temperature 20 F and Below: Heat sand and mixing water to minimum of 70 F and maximum of 160 F. Provide enclosure and auxiliary heat to maintain air temperature above 32 F. Temperature of units when laid shall be not less than 20 F.

B. Protection Requirements (Completed Masonry or Sections Not Being Worked On)
   1. Mean Daily Air Temperature 40 F to 32 F: Protect masonry from rain or snow for 24 hrs.
   2. Mean Daily Air Temperature 32 F to 25 F: Completely cover masonry for 24 hrs.
   3. Mean Daily Air Temperature 25 F to 20 F: Completely cover masonry with insulating blankets for 24 hrs.
   4. Mean Daily Air Temperature 20 F and Below: Maintain masonry temperature above 32 F for 24 hrs. by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps or other approved method.

C. No masonry shall be laid when the ambient temperature is below 40 degrees F. All masonry shall be laid plumb, true to line and level, with accurately spaced courses, with each course breaking joints with the course below, unless noted otherwise on the drawings. A story pole and template shall be used and work checked with a surveying instrument to maintain level coursing.

D. Work required to be built into masonry, including anchors, frames, bolts, sleeves, inserts, compressible fillers, expansion joints and flashing shall be built in as erection progresses. Concrete block into which anchor bolts will be installed shall be filled solid with mortar.

E. Laying Out Block Work: All concrete block work shall be

laid out with uniform joints approximately 3/8" thick and shall be bonded at corners where possible and as consistent with good appearance. Where cutting is required, the cuts shall be made symmetrical above openings and as a general rule with no cuts less than 4" with power equipment designed for purpose.

F. Corners shall be made using half blocks in order to maintain head joints centered over block in adjoining courses above and below. Where intersecting masonry partitions occur, galvanized Durowall Joint Reinforcing shall be used at every 2nd course.

1. Concrete blocks shall be laid dry in a full bed of mortar and ends buttered on both edges. Care shall be used to prevent smearing mortar on exposed faces of the blocks and such accumulations that occur shall be removed immediately. The exposed face of blocks shall be wiped clean with burlap as the work proceeds. Those surfaces exposed to sight in their final position shall be further cleaned to provide for the application of finishes as required.
2. Joints in block work shall be tooled concave in such a manner as to squeeze the mortar back into the joints and to ensure complete contact is made along the edges of the units, compressing and sealing the surface of the joints.
3. Control joints shall be provided in concrete block partitions at door heads where masonry extends above the door frames, where partitions abut exterior walls and elsewhere as noted on the drawings. Joints shall be raked out 3/8" deep and caulked as specified in Division 7. Bond beams shall be installed as indicated and shall be filled with concrete and reinforced with two (2) No. 4 bars unless noted otherwise.

G. Lintels shall be provided where shown and for all openings in masonry work where other types of lintels have not been provided. Concrete block lintels shall bear not less than six inches (6") on each jamb. Lintel blocks shall be solid bottom trough block filled with concrete and reinforced as detailed on drawings.

H. Masonry Reinforcement: Joint reinforcement shall be installed in all concrete block partitions in the joints of every second block course for the full height of the wall.

I. Brick: Provide a 3/8" mortar bed with concave tooled horizontal and vertical joints. Refer to drawings for

vertical coursing as related to openings and other features. Brickwork is to be brushed down daily to remove large pieces of mortar slag. At completion of brick masonry work, all exposed masonry surfaces shall be thoroughly cleaned and washed down with clean water and a stiff bristled brush or as recommended by the brick manufacturer and as approved by the Design/Builder. The brick masonry work shall be left in a state exhibiting properly and fully pointed joints and completely clean surfaces. Subcontractor shall build-in all features of brickwork as shown or indicated on the drawings including weeps, special coursing and or patterned elements.

J. The Subcontractor shall be responsible for furnishing all required labor, tools, and equipment as required to complete all areas of masonry work on the project. This shall be inclusive of all scaffolding, walk-boards and bracing as required to support the work until fully incorporated into the structure.

K. Subcontractor shall also furnish all materials save for the brick units as called out above. These materials include concrete block, mortar, reinforcing, ties and other accessories necessary for the execution of the masonry work.

3.03 Preparation:

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

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

3.04 Coursing:

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:

1. Bond: Running.
2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm) vertically.
3. Mortar Joints: Concave.

D. Brick Units:

1. Bond: Running.
2. Coursing: Three units and three mortar joints to equal 8 inches (200 mm) vertically.
3. Mortar Joints: Concave.

3.05 Placing and Bonding:

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Masonry work shall be laid true to dimensions, plumb, square and in bond and properly anchored with vertical joints in line, plumb and true.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

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

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

F. Interlock intersections and external corners.

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

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

I. Provide a 3/8” joint around hollow metal door jambs and window frames to allow for sealant and expansion.

3.06 Weeps/Cavity Vents:

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

3.07 Reinforcement and Anchorage – General:

A. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches (900 mm) horizontally and 24 inches (600 mm) vertically.

B. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (900 mm) around perimeter.

C. Locate anchor sections to allow maximum vertical differential movement of ties up and down.

3.08 Reinforcement And Anchorage - Concrete Masonry Units:

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 8 inches (200 mm) on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.

C. Place continuous joint reinforcement in first and second joint below top of walls.

D. Lap joint reinforcement ends minimum 6 inches (150 mm).

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

3.09 Reinforcement And Anchorage - Masonry Veneer:

A. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.10 Masonry Flashings:

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Extend flashings full width at such interruptions and at least 4 inches into adjacent masonry or turn up at least 4 inches to form watertight pan at non-masonry construction.
   2. Remove or cover protrusions or sharp edges that could puncture flashings.
   3. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Extend metal flashings through exterior face of masonry and turn down to form drip. Install joint sealer below drip edge to prevent moisture migration under flashing.

C. Lap end joints of flashings at least 4 inches and seal watertight with mastic or elastic sealant.

3.11 Lintels:

A. Install loose steel lintels over openings.

3.12 Control Joints:

A. Do not continue horizontal joint reinforcement through control joints.

B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

C. Size control joint in accordance with Section 07900 for sealant performance.

3.13 Built-In Work:

A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.

D. Do not build into masonry construction organic materials that are subject to deterioration.

3.14 Tolerances:

A. Maximum Variation from Alignment of Columns: 1/4 inch.
B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
F. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.
G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.15 Cutting And Fitting:

A. Cut and fit for pipes and conduit. Coordinate with other sections of work to provide correct size, shape, and location.
B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.16 Cleaning:

A. Remove excess mortar and mortar droppings.
B. Clean soiled surfaces with cleaning solution.

3.17 Protection Of Finished Work:

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

End of Section

DIVISION 5 – STRUCTURAL STEEL

SECTION 05120 – STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.01 Section Includes
- A. Structural steel framing members.
- B. Base plates, shear stud connectors and anchor rods.
- C. Grouting under base plates.

1.02 Related Requirements
- A. Section 05 2100 - Steel Joist Framing.
- B. Section 05 3100 - Steel Decking: Support framing for small openings in deck.
- C. Section 05 5000 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.03 Reference Standards
- A. For all reference standards listed below, comply with the version year in the governing building code adopted by the Authority Having Jurisdiction. For those reference standards that are not directly referenced by the building code, use the latest edition unless noted otherwise.
- B. AISC (MAN) - Steel Construction Manual.
- C. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.
- D. AISC 360 - Specification for Structural Steel Buildings.
- E. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
- F. ASTM A29/A29M - Standard Specification for Steel Bars, Carbon Alloy, Hot-Wrought, General Requirements.
- G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- J. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- K. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- L. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- M. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- N. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
- O. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric).

P. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
Q. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
R. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
S. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.
T. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film.
U. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments.
V. ASTM E165/E165M - Standard Test Method for Liquid Penetrant Examination for General Industry.
W. ASTM E709 - Standard Guide for Magnetic Particle Testing.
X. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
Y. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
Z. ASTM F1852 - Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
AA. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
AB. AWS D1.1/D1.1M - Structural Welding Code - Steel.
AC. ICC (IBC)-2015 - International Building Code.
AD. MPI #79 - Primer, Alkyd, Anti-Corrosive for Metal.
AE. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections.
AF. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").
AG. SSPC-SP 3 - Power Tool Cleaning.
AH. SSPC-SP 6 - Commercial Blast Cleaning.

1.04 Submittals

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings:
1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
2. Indicate cambers and loads.
3. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
D. Product Data: For shop primers, include manufacturer's technical information including basic materials analysis and application instructions.
E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.05 Quality Assurance
A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
B. Fabricator Qualifications:
1. A steel fabricator specializing in performing the work of this section with minimum 10 years of experience.
C. Erector Qualifications:
1. An erector specializing in performing the work of this section with minimum 5 years of experience.

1.06 Delivery, Storage And Handling
A. Comply with the requirements of the General Conditions and of ASTM A6/A6M, including the following.
B. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
C. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.01 Materials
A. Steel Angles, Plates, and Channels: ASTM A36/A36M.
B. Steel W Shapes and Tees: ASTM A992/A992M.
C. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade C.
D. Pipe: ASTM A53/A53M, Grade B, Finish black.

E. Headed Stud Anchors: AWS D1.1 Type B, ASTM A29 Grades 1010 through 1020.
F. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M, Class C.
G. High-Strength Structural Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade C heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
H. Tension Control Bolts: Twist-off type: ASTM F1852.
I. Unheaded Anchor Rods: ASTM F1554, Grade 55 , Supplementary Requirement S1, Weldable, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436/F436M Type 1 washers.
J. Deformed Bar Anchors: AWS D1.1/D1.1M Type C, ASTM A1064 Grade 70.
K. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
L. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
    1. Minimum Compressive Strength at 48 Hours: 3000 pounds per square inch.
    2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
    3. Height Change, Plastic State; when tested according to ASTM C827/C827M:
        a. Maximum: Plus 4 percent.
        b. Minimum: Plus 1 percent.
M. Shop and Touch-Up Primers: As required below, complying with VOC limitations of authorities having jurisdiction.
    1. Steel Exposed to Exterior Weather or an Uncontrolled Environment: Two-component, high performance, zinc-rich, aromatic urethane, compatible with topcoat and complying with SSPC-Paint 20.
    2. Interior Steel: Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI #79 and compatible with topcoat.
N. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

2.02 Fabrication

A. Shop fabricate to greatest extent possible. Fabricate according to AISC 303 and to AISC 360.
B. Fabricate connections for bolt, nut, and washer connectors.
C. Develop required camber for members.
D. Fabricated uncambered beams with rolling camber up.

2.03 Finish

A. Prepare structural component surfaces in accordance with SSPC-SP3 for interior steel or SSPC-SP6 for all steel exposed to exterior weather or an uncontrolled environment.

B. Shop prime structural steel members:

1. Do not prime surfaces that will be galvanized, fireproofed, field welded, in contact with concrete, or [in slip surfaces of slip-critical connections].
2. All steel exposed to exterior weather or an uncontrolled environment shall be blast cleaned and primed with a submitted and approved zinc-rich primer.
3. Interior steel shall be shop primed with the fabricators standard shop primer.

C. Galvanize structural steel members to comply with ASTM A123/A123M.

2.04 Source Quality Control & Quality Assurance

A. Unless the fabricator is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel, an independent testing agency will perform Special Inspections and field quality control and quality assurance tests in the fabricator's shop as required by Chapter 17 of ICC (IBC)-2015 and Chapter N of AISC 360. Refer to the following parts of the structural drawings for additional Special Inspection requirements.

1. Statement of Special Inspection Notes
2. Two tables titled "Required Verification and Inspection of Steel Construction"

PART 3 - EXECUTION

3.01 Examination

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

3.02 Erection

A. Erect structural steel in compliance with AISC 303.

B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing. Refer to the "Construction Loads and Stability" section of the General Notes in the Project Drawings for additional information and requirements.

C. Field weld components, deformed bar anchors and shear studs indicated on shop drawings.

D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on

drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".

E. Do not field cut or alter structural members without approval of Structural Engineer.

F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for non-shrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 Field Quality Control & Quality Assurance

A. An independent testing agency will perform Special Inspections and field quality control and quality assurance tests as required by Chapter 17 of ICC (IBC)-2015 and Chapter N of AISC 360. Refer to the following parts of the structural drawings for additional Special Inspection requirements:

1. Statement of Special Inspection Notes
2. Two tables titled "Required Verification and Inspection of Steel Construction"

END OF SECTION

DIVISION 5 – STRUCTURAL STEEL

SECTION 05210 – STEEL JOIST FRAMING

PART 1 – GENERAL

1.01 Section Includes
- A. Open web steel joists, with bridging, attached seats and anchors.
- B. Loose bearing members, such as plates or angles, and anchor bolts for site placement.
- C. Supplementary framing for floor and roof openings greater than 8 inches.

1.02 Related Requirements
- A. Section 05 1200 - Structural Steel Framing: Grouting base plates and bearing plates. Superstructure framing.
- B. Section 05 1200 - Structural Steel Framing: Superstructure framing.
- C. Section 05 3100 - Steel Decking: Bearing plates and angles.
- D. Section 05 5000 - Metal Fabrications: Non-framing steel fabrications attached to joists.

1.03 Reference Standards:
- A. For all reference standards listed below, comply with the version year in the governing building code adopted by the Authority Having Jurisdiction. For those reference standards that are not directly referenced by the building code, use the latest edition unless noted otherwise.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- E. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- F. ASTM A436 - Standard Specification for Austenitic Gray Iron Castings.
- G. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
- H. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.
- I. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- J. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel.
- K. ICC (IBC)-2015 - International Building Code.
- L. SJI JG-10 - Standard Specification for Joist Girders.
- M. SJI K-10 - Standard Specification for Open Web Steel Joists, K-Series.

N. SJI LH/DLH-10 - Standard Specification for Longspan Steel Joists, LH-series and Deep Longspan Steel Joists, DLH-series.
O. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders.
P. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
Q. SSPC-SP 2 - Hand Tool Cleaning.

1.04 Submittals

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.
C. Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.
D. Manufacturer's Qualification Statement.
E. Comprehensive engineering analysis of all joists signed and sealed by the qualified professional engineer licensed in the state of the project responsible for its preparation.
F. Manufacturer's Certification: At completion of manufacture, the steel joist manufacturer shall submit a certificate of compliance to the owner’s authorized agent for submittal to the building official as specified in Section 1704.5 of ICC (IBC)-2015 stating that work was performed in accordance with approved construction documents and with the SJI specifications listed herein.

1.05 Quality Assurance

A. Perform Work, including that for headers and other supplementary framing, in accordance with SJI JG-10, SJI K-10, and SJI LH/DLH-10 and SJI Technical Digest No. 9.
B. Manufacturer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.06 Delivery, Storage, And Handling

A. Transport, handle, store, and protect products to SJI requirements.

PART 2 - PRODUCTS

2.01 Materials

A. Open Web Joists: Types as indicated on drawings:
1. Minimum End Bearing on Steel Supports: Comply with referenced SJI standard.

2. Minimum End Bearing on Concrete or Masonry Supports: Comply with referenced SJI standard.
3. Finish: Shop primed.

B. Anchor Bolts, Nuts and Washers: ASTM A307, hot-dip galvanized per ASTM A153/A153M, Class C.

C. High-Strength Structural Bolts, Nuts, and Washers: ASTM A325 with matching compatible ASTM A563 nuts and ASTM A436 washers.

D. Headed Stud Anchors: [AWS D1.1 Type B, ASTM A29 Grades 1010 through 1020].

E. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36/A36M.

F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.02 Finish

A. Shop prime joists as specified.
1. Do not prime surfaces that will be fireproofed.

B. Prepare surfaces to be finished in accordance with SSPC-SP2.

2.03 Source Quality Control

A. Welded Connections: Visually inspect all shop-welded connections.

PART 3 - EXECUTION

3.01 Examination

A. Verify existing conditions prior to beginning work.

3.02 Erection

A. Erect joists in compliance with SJI Technical Digest No. 9 and all applicable provisions of OSHA safety standards.

B. Erect joists with correct bearing on supports.

C. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.

D. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.

E. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.

F. Position and field weld joist chord extensions and wall attachments as detailed.

G. Install supplementary framing for floor and roof openings greater than 8 inches.

H. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.

I. Do not field cut or alter structural members without approval of joist manufacturer.

J. After erection, prime welds, damaged shop primer, and surfaces not shop primed, except surfaces specified not to be primed.

3.03 Tolerances

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Alignment: 1/4 inch.

3.04 Field Quality Control

A. An independent testing agency will perform Special Inspections and field quality control as required by Chapter 17 of ICC (IBC)-2015. Refer to the following parts of the structural drawings for additional Special Inspection requirements.

1. Statement of Special Inspection Notes
2. Table 1705.2.3 titled "Required Special Inspections of Open-Web Steel Joists and Joist Girders"

END OF SECTION

DIVISION 5 – STRUCTURAL STEEL

SECTION 05310 – STEEL DECKING

PART 1 – GENERAL

1.01 Section Includes
- A. Roof deck.
- B. Supplementary framing for openings up to and including 8 inches.
- C. Bearing plates and angles.

1.02 Related Requirements
- A. Section 05 1200 - Structural Steel Framing: Support framing for openings larger than 8 inches and shear stud connectors.
- B. Section 05 2100 - Steel Joist Framing: Support framing for openings larger than 8 inches.
- C. Section 05 5000 - Metal Fabrications: Steel angle concrete stops at deck edges.

1.03 Reference Standards
- A. For all reference standards listed below, comply with the version year in the governing building code adopted by the Authority Having Jurisdiction. For those reference standards that are not directly referenced by the building code, use the latest edition unless noted otherwise.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- E. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- F. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.
- G. ICC (IBC)-2015 - International Building Code.
- H. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks.
- I. SDI (QA/QC) - Standard for Quality Control and Quality Assurance for Installation of Steel Deck.
- J. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").

1.04 Submittals
- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
- D. Submit manufacturer's installation instructions.

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

1.05 Quality Assurance

A. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck shall be in accordance with the quality assurance inspection requirements of SDI (QA/QC).

B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of experience.

1.06 Delivery, Storage, And Handling

A. Cut plastic wrap to encourage ventilation.

B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 - PRODUCTS

2.01 Steel Deck

A. Roof Deck: Non-composite type, fluted steel sheet:

1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G60/Z180 galvanized coating.

2. Structural Properties: As indicated in General Notes.

2.02 Accessory Materials

A. Bearing Plates and Angles: ASTM A36/A36M steel, galvanized per ASTM A123/A123M.

B. Welding Materials: AWS D1.1/D1.1M.

C. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping.

D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

E. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

2.03 Fabricated Deck Accessories

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

B. Roof Sump Pans: Formed sheet steel, 14 gauge, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 - EXECUTION

3.01 Examination

A. Verify existing conditions prior to beginning work.

3.02 Installation

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. On concrete and masonry surfaces provide minimum 4 inch bearing.

C. On steel supports provide minimum 2 inch bearing at discontinuous ends of deck and minimum 3 inch bearing length of continuous roof deck over interior supports.

D. Fasten deck to steel support members as indicated at spacings indicated on the drawings using methods specified.

E. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.

F. Where roof deck changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Attach both sides of cover plate to roof deck below with the same fasteners and spacings as required for deck to supports.

G. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

H. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

3.03 Field Quality Control

A. An independent testing agency will perform Special Inspections and field quality control tests as required by Chapter 17 of ICC (IBC)-2015 and SDI (QA/QC). Refer to the following parts of the structural drawings for additional Special Inspection requirements:

1. Statement of Special Inspection Notes
2. Table titled "Required Inspection of Cold-Formed Steel Deck"

B. Concurrent with the submittal of special inspection reports to the Owner's Representative, the special inspector shall submit to the Owner's Representative and the Installer a list of nonconforming items.

END OF SECTION

DIVISION 5 – METALS

SECTION 05400 – COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 Related Documents

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

1.02 Summary

A. This Section includes the following:
   1. Exterior and interior non-load-bearing wall framing.
   2. Soffit joist framing.

B. Related Sections include the following:
   1. Division 5 Section "Metal Fabrications" for masonry shelf angles and connections.
   2. Division 9 Section "Gypsum Board Assemblies" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.03 Performance Requirements

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: Design loads shall be calculated components and cladding load per ASCE/SEI 7 edition indicated on the drawings.
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/600 of wall height at areas backing up brick veneer, and 1/240 of wall height at areas backing up other materials.
      b. Soffit Joist Framing: Vertical deflection of 1/240 of the span.
   3. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. Upward and downward movement of 1 inch.

B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
   1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
   2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

SECTION 05400 – COLD-FORMED METAL FRAMING

1.04 Submittals

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Research/Evaluation Reports: For cold-formed metal framing.

1.05 Quality Assurance

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

D. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

1.06 Delivery, Storage, And Handling

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

SECTION 05400 – COLD-FORMED METAL FRAMING

PART 2 - PRODUCTS

2.01 Manufacturers

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
   1. Allied Studco.
   2. AllSteel Products, Inc.
   3. California Expanded Metal Products Company.
   4. Clark Steel Framing.
   5. Consolidated Fabricators Corp.; Building Products Division.
   6. Craco Metals Manufacturing, LLC.
   7. Custom Stud, Inc.
   8. Dale/Incor.
   9. Design Shapes in Steel.
   10. Dietrich Metal Framing; a Worthington Industries Company.
   11. Formetal Co. Inc. (The).
   12. Innovative Steel Systems.
   13. MarinoWare; a division of Ware Industries.
   14. Quail Run Building Materials, Inc.
   15. SCAFCO Corporation.
   16. Southeastern Stud & Components, Inc.
   17. Steel Construction Systems.
   18. Steeler, Inc.
   19. Super Stud Building Products, Inc.
   20. United Metal Products, Inc.

2.02 Materials

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: ST33H (ST230H).
   2. Coating: G60 (Z180).

B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: 50 (340), Class 1 or 2.
   2. Coating: G90 (Z275).

2.03 Exterior Non-Load-Bearing Wall Framing

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inches (1.09 mm).
   2. Flange Width: 1-5/8 inches (41 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0538 inches (1.37 mm)
   2. Flange Width: 1-1/2 inches.

C. Vertical Deflection Clip Option: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dietrich Metal Framing; a Worthington Industries Company.
      b. MarinoWare, a division of Ware Industries.
      c. SCAFCO Corporation
      d. The Steel Network, Inc.

D. Single Deflection Track Option: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
   1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
   2. Flange Width: 1 inch (25 mm) plus the design gap for 1-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

E. Double Deflection Track Option: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
   1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
      a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
      b. Flange Width: 1 inch (25 mm) plus the design gap for 1-story structures and 1 inch (25 mm) plus twice the design gap for other applications.
   2. Inner Track: Of web depth indicated, and as follows:
      a. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
      b. Flange Width: Equal to sum of outer deflection track flange width plus 1 inch.

2.04 Soffit Joist Framing

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depth indicated, unpunched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: As indicated on drawings.
   2. Flange Width: 1-5/8 inches (41 mm) minimum.

2.05 Framing Accessories

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.
   5. End clips.
   6. Foundation clips.
   7. Gusset plates.
   8. Stud kickers, knee braces, and girts.
   9. Joist hangers and end closures.
   10. Hole reinforcing plates.
   11. Backer plates.

2.06 Anchors, Clips, And Fasteners

A. Anchor Bolts: ASTM F 1554, Grade 55, threaded carbon-steel headless bolts, with encased end threaded, and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C or mechanically deposition according to ASTM B 695, Class 50.

B. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.07 Miscellaneous Materials

A. Galvanizing Repair Paint: ASTM A 780.

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.08 Fabrication

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening

requirements of sheathing or other finishing materials.

2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.01 Examination

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.02 Installation, General

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.

2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for

which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 7 Section "Building Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.03 Exterior Non-Load-Bearing Wall Installation

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to bottom track, unless otherwise indicated. Fast both flanges to top track if required by deflection option selected. Space studs as follows:

1. Stud Spacing: 16 inches (406 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Single Deflection Track Option: Install single-leg deflection tracks and anchor to building structure.
2. Double Deflection Track Option: Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Deflection Clip Option: Connect vertical deflection clips to infill studs and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
   1. Top Bridging for Single Deflection Track Option: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
      a. Install solid blocking at maximum 96-inch (2440-mm) centers and as shown on approved Shop Drawings.
   2. Bridging Options:
      a. Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
      b. Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
      c. Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.04 Joist Installation

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
   1. Unless shown otherwise in drawings, install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
   2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on drawings.

C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
   1. Joist Spacing: As indicated.

D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.
E. Install bridging at intervals indicated. Fasten bridging at each joist intersection as follows:
   1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
F. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.05 Field Quality Control

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
B. Field and shop welds will be subject to testing and inspecting.
C. Testing agency will report test results promptly and in writing to Contractor and Architect.
D. Remove and replace work where test results indicate that it does not comply with specified requirements.
E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.06 Repairs And Protection

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensures the cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

DIVISION 5 – STRUCTURAL STEEL

SECTION 05500 – METAL FABRICATIONS

PART 1 – GENERAL

1.01 Section Includes
- A. Shop fabricated steel items.

1.02 Related Requirements
- A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 04 2000 - Unit Masonry: Placement of metal fabrications in masonry.
- C. Section 05 1200 - Structural Steel Framing: Structural steel column anchor bolts.
- D. Section 05 2100 - Steel Joist Framing: Structural joist bearing plates, including anchorage.
- E. Section 05 3100 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.
- F. Section 05 5100 - Metal Stairs.

1.03 Reference Standards
- A. For all reference standards listed below, comply with the version year in the governing building code adopted by the Authority Having Jurisdiction. For those reference standards that are not directly referenced by the building code, use the latest edition unless noted otherwise.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- H. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- J. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- K. MPI #79 - Primer, Alkyd, Anti-Corrosive for Metal.
- L. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").

SECTION 05500 – METAL FABRICATIONS

1.04 Submittals

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

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.

a. Include the following, as applicable:

1) Design criteria.

2) Engineering analysis depicting stresses and deflections.

3) Member sizes and gauges.

4) Details of connections.

5) Support reactions.

6) Bracing requirements.

PART 2 – PRODUCTS

2.01 Materials - Steel

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.

F. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.

G. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.

H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

I. Shop and Touch-Up Primer: As required below, complying with VOC limitations of authorities having jurisdiction.

1. Steel Exposed to Exterior Weather or an Uncontrolled Environment: Two-component, high performance, zinc-rich, aromatic urethane, compatible with topcoat and complying with SSPC-Paint 20.

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

J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

2.02 Fabrication

A. Fit and shop assemble items in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 Fabricated Items

A. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking and joists; prime paint finish.
B. Lintels: As detailed; prime paint finish.
C. Door Frames for Overhead Door Openings and Wall Openings: Channel sections; prime paint finish.
D. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.
E. Toilet Partition Suspension Members: Steel channel sections; prime paint finish.

2.04 Finishes - Steel

A. Prime paint steel items.
    1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.
    2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
B. Prepare surfaces to be primed in accordance with SSPC-SP3 for interior steel or SSPC-SP6 for all steel exposed to exterior weather or an uncontrolled environment.
C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
D. Prime Painting: One coat.
E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.05 Fabrication Tolerances

A. Squareness: 1/8 inch maximum difference in diagonal measurements.
B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.
D. Maximum Bow: 1/8 inch in 48 inches.
E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 – EXECUTION

3.01 Examination
A. Verify that field conditions are acceptable and are ready to receive work.
3.02 Preparation
A. Clean and strip primed steel items to bare metal where site welding is required.
B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.
3.03 Installation
A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
C. Field weld components as indicated on drawings.
D. Perform field welding in accordance with AWS D1.1/D1.1M.
E. Obtain approval prior to site cutting or making adjustments not scheduled.
F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
3.04 Tolerances
A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.
C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

DIVISION 11 - EQUIPMENT

SECTION 05515 - ALUMINUM LADDERS

Part 1 - General

1.01 Work Included:
- A. The General Conditions and applicable sections of Division 1 shall apply to this entire section.
- B. All materials, labor, services, and incidentals necessary for the completion of this entire section of the work.

1.02 Submittals:
- A. Provide manufacturer's catalog cut and data sheets, complete parts list and installation requirements for each item specified.

1.03 Product Delivery, Storage, and Handling:
- A. Handle and store all items with care to prevent damage and injury to finish surfaces.

1.04 Related Work Specified Elsewhere:
- A. Section 06100 - Rough Carpentry.
- B. Section 07700 - Roof Accessories

Part 2 - Products

2.01 Products of the manufacturers listed below have been specified herein to simplify descriptions of design, construction, and materials only. All items have been selected for visual and performance design quality which shall serve as a basis for acceptance of equivalent products by other manufacturers.

2.01 Manufacturer:
- A. Acceptable Manufacturer: UPNOVR, Inc.; Hooksett, NH 03106.

2.02 Aluminum Vertical Access Ladders:
- A. Vertical Roof Hatch Rail Extension Ladder:
  1. Model Number: U-200.
  2. Materials: ASTM B221, Alloy 6063, Temper T-6, non-spark extruded aluminum and ASTM B209, Alloy 6063 Temper T-6 sheet aluminum.
  3. Aluminum Finish: Mill finish.
  4. Nominal Height: As indicated on the Drawings.
  5. Side Rails: 1-3/4 inches wide by 3 inch tubes with 1/8 inch wall thickness.
  6. Rungs: 1-1/4 inches wide by 1-1/4 inches tube with corrugated surfaces and capable of 1,000 pound load. Space 12 inches on center. Attach rungs in centerline of side rails by welding.
  7. Rung Length: 24 inches.
- B. Accessories:
  1. Wall Brackets: 2 inch by 1/4 inch minimum flat bar aluminum wall brackets.
  2. Safety Post Extension: Post extension for fixed

ladders constructed of tubular aluminum sections with adjustable mounting brackets for attachment to top of ladder. Permanently mount operating instructions on safety post to be plainly visible to ladder users.

Part 3 Execution

3.01 Preparation:

A. Do not begin installation until substrates have been properly prepared. Notify Architect of unsatisfactory conditions before commencing work.

B. Field verify required dimensions. Coordinate with supporting construction to ensure adequate blocking and support.

C. Coordinate with requirements of roof hatch to ensure height and position of ladder is compatible with roof hatch curb and required clearances.

D. Isolate dissimilar metals to prevent electrolysis with bituminous paint or non-absorptive isolation pad to prevent contact.

3.02 Installation:

A. Install ladders and accessories in accordance with manufacturer's instructions and approved submittals.

1. Securely anchor support brackets with fasteners of type and size recommended by manufacturer.
2. Place brackets at top and bottom and at 48 inches maximum intermediate points.
3. Allow 7 inches minimum clearance from wall to center line of rungs.
4. Inspect ladder to verify proper and secure installation.
5. Hold ladder brackets a minimum of 6” above roofing membrane.

B. If applicable, install security door assembly and adjust for smooth operation.

C. At roof hatch access ladder, install safety post extension by attaching to top 2 rungs of ladder, centered between side rails. Adjust post to extend 42 inches above top rung when roof hatch is open and post is fully extended.

3.03 Cleaning:

A. Clean ladders as recommended by manufacturer. Do not use abrasive agents, steel wool or chemicals.

End of Section

DIVISION 6 - WOOD & PLASTIC

SECTION 06100 - ROUGH CARPENTRY

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this section of the work.

1.02 Related Work Specified Elsewhere:
- A. Wood Treatment - Section 06300

1.03 Quality Assurance:
- A. Grades specified shall conform to the most recent grading rules as established by the following bureaus and associations.
  1. PS 20 - American Softwood Lumber Standard.
  2. Western Wood Products Association
  3. Southern Pine Inspection Bureau
- B. Grade and trade mark each piece of lumber or bundle on bundled stock. Use only the recognized official marks of association under whose rules it is graded. Grade and trade marks will not be required if each shipment is accompanied by certificate of inspection issued by grading association.

1.04 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 materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer’s written instructions for handling, storing, installing and finishing treated material.
  2. As requested by authorities having jurisdiction include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply wit requirements. Include physical properties of treated materials both before and after exposure to elevated temperatures when tested according to ASTM D5516 and ASTM D 5664.
  3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

4. Research / evaluation reports – for the following, showing compliance with building code in effect for Project:
   a. Fire-retardant treated wood.
   b. Power-driven fasteners.
   c. Power-actuated fasteners.
   d. Expansion anchors.
   e. Metal framing anchors.

1.05 Delivery, Storage and Handling:

A. Stack lumber, plywood, sheathing, and other materials: provide spacers between each bundle to provide air circulation around bundled material. Provide proper air circulation between stacks and under coverings.

Part 2 - Products

2.01 General:

A. Provide best quality of respective grades and kinds. Lumber and plywood shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship". Factory mark each piece of lumber with grade stamp of grading agency.

B. Maximum moisture content of lumber 19%.

C. Provide dressed lumber (S4S) unless otherwise indicated.

D. Where nominal sizes are indicated, provide actual sized required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

2.02 Grades and Applications of Lumber:

A. Framing lumber for the following shall be "Standard" grade Douglas Fir (WCLIB or WWPA).
   1. Concealed blocking/nailers, cants, grounds, and miscellaneous wood items used in conjunction with the roofing work and as indicated on the Drawings.
   2. Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the Grading Agency indicated.

2.03 Fire-retardant Treated Materials:

A. General – where fire-retardant treated materials are required by authorities having jurisdiction, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant treated wood with appropriate classification

marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

2.04 Panel Products:

A. Miscellaneous Concealed Plywood: shear wall sheathing, span rating to suit framing in each location, and thickness indicated. Refer to Structural Drawings.

B. Telephone and Electrical Equipment Backing Panels: DOC PS 1, C-D Plugged, fire-retardant treated, in thickness indicated, or if not indicated, not less than ½ inch thick.

2.05 Fasteners:

A. All nails, spikes, bolts, connectors and other fasteners used in connections with this work shall be galvanized.

1. Nails, wire, brads and staples – FS-FF-N-105.
2. Power-driven Fasteners – CABO NER-272.
3. Wood screws – ASME B18.6.1.
4. Screws for fastening to cold formed metal framing: ASTM C954 length as recommended by screw manufacturer for material to be fastened.
5. Lag bolts – ASME B18.2.1.
6. Bolts – steel bolts complying with ASTM A 307, Grade A with ASTM C563 hex nuts and, where indicated, flat washers.
7. Expansion anchors – anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
   a. Material for interior applications: carbon steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
   b. Material for exterior applications: stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, alloy group 1 or 2.

2.06 Metal Framing Anchors:

A. General: provide galvanized steel framing anchors of structural capacity, type, and size indicated and acceptable to authorities having jurisdiction.

B. Galvanized Steel Sheet: hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

Part 3 - Execution

3.01 Sizes and Applications (General Framing):

A. Members shall be accurately cut and fitted, true to line and level, avoiding shims and wedges as much as possible. Discard material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Where applicable, apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

C. At wood ground, blocking and nailer installation: install where indicated and 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.

D. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless noted otherwise.

3.02 Rough Hardware:

A. Provide all sufficient nails, screws, etc. to insure rigidity and structural soundness. Provide hot-dipped galvanized fasteners at all weather exposed locations.

B. Spiking and nailing shall be done using largest size spikes and nails practicable and as indicated on the drawings. Securely attach carpentry according to applicable codes and recognized standards.

C. Bolt nailers and blocking to steel or concrete members with bolts of proportionate strength of members attached, length required, spaced 4'-0" o.c. maximum and 4" from each end, except as otherwise indicated. Countersink fastener heads on exposed carpentry work and fill holes with wood fiber.

D. Predrill members when necessary to avoid splitting of wood.

3.03 Panel Product Installation:

A. Wood structural panels: comply with applicable recommendations contained in APA Form No. E30K, “APA Design/Construction Guide: Residential and Commercial”, for types of structural-use panels and applications indicated. Comply with “Code Plus” provisions in above referenced guide.

End of Section

SECTION 06200 - FINISH CARPENTRY

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this section of the work.
- B. The erection of wall and partition wood finish materials, installation of door and hardware, and shelving incidentals necessary to finish the carpentry.

1.02 Related Work Specified Elsewhere:
- A. Wood Doors - Section 08200
- B. Hardware and Specialties - Section 08700

1.03 Quality Assurance:
- A. Standards:
  1. Architectural Woodwork Institute:
     a. Architectural Woodwork Quality Standards.
  2. National Electrical Manufacturers Association:
     a. NEMA Publication LD-1.
  3. Western Wood Products Association:
     a. Standard Grading Rules for Western Lumber.
  4. American Plywood Association:

1.05 Product Delivery, Storage and Handling:
- A. All finish materials, trim, etc. shall be inspected to insure that no sub-grade, defective, or machine-marked pieces are installed.

Part 2 - Products

2.01 General:
- A. Grades specified shall conform to the most recent grading rules of the association or bureau under whose rules the lumber is produced.
- B. Quality standards specified shall conform to the latest edition of the Architectural Woodwork Institute's "Quality Standards".
- C. Lumber shall be kiln-dried to 10% to 12% moisture content which shall be maintained during the fabrication of millwork and cabinetry.

Part 3 - Execution

3.01 Miscellaneous Trim and Frames:
- A. Install all trim in longest possible lengths. Stagger joints in adjacent member. Cope at returns and miter at corners. Attach securely in place with fine finishing nails where exposed; set for filling.

B. Immediately prior to final inspection of building, the contractor shall repair or replace all millwork or cabinetry items which have been damaged in any way.

End of Section

SECTION 06300 - WOOD TREATMENT

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this section of the work.

1.02 Quality Assurance:
- A. Standards:
  1. American Wood Preservers Association:
     - a. AWPA Standard P-5 (Preservative)
     - b. AWPA Standard Commodity Standards (Treating Process).
  2. Federal Specifications:
     - a. TT-W-550 (Preservative).
     - b. TT-W-571 (Treating Process).
- B. All lumber and plywood receiving wood treatment shall bear the trademark of the process used.
- C. Submit certificate and guarantee of the lumber treated.

Part 2 - Products

2.01 Materials:
- A. Description: Waterborne chemical salts intended for pressure impregnation as a wood preservative. Preservatives with a petroleum vehicle are not permitted.

Part 3 - Execution

3.01 Installation:
- A. Location of treated lumber:
  1. All blocking, plates, nailers and curbs used in conjunction with gravel guards, roof edges and all other wood components used in the roofing project.
- B. Materials shall be pressure treated in accordance with the standards of the American Wood Preservers Institute and the chemical manufacturer's specifications.
- C. Treated material shall conform to AWPB LD-2 and treated to a maximum retention of 0.23 pound of oxide per cubic foot.
- D. Moisture content of finish products shall not exceed 19%.

End of Section

SECTION 06420 - CUSTOM LAMINATE CASEWORK

PART 1 – GENERAL

1.01 SECTION INCLUDES
- A. Fixed modular laminate clad casework and components.
- B. Flexible rail mounted laminate clad casework and components.
- C. Solid Surface countertops and backsplash.

1.02 RELATED SECTIONS
- A. Blocking within walls where indicated: Section 06100 Rough Carpentry.
- B. Millwork, trim, etc.: Section 06200 Finish Carpentry.
- C. Hardware: Section 06410 Custom Casework.
- D. Glass: not applicable.
- E. Base molding: Division 9.
- F. Appliances: Division 11 and drawings.
- G. Sinks and service fixtures, service waste lines, connections, and vents: Division 15.
- H. Electrical service fixtures: Division 16.

1.03 DEFINITIONS
- A. Identification of casework components and related products by surface visibility.
  1. Open Interiors: Any open storage unit without solid door or drawer fronts, units with full glass insert doors and/or acrylic doors, and units with sliding solid doors.
  2. Closed Interiors: Any closed storage unit behind solid door or drawer fronts.
  3. Exposed Ends: Any storage unit exterior side surface that is visible after installation.
  4. Other Exposed Surfaces: Faces of doors and drawers when closed, and tops of cabinets less than 72 inches above furnished floor.
  5. Semi-Exposed Surfaces: Interior surfaces which are exposed to view when doors or drawers are opened, bottoms of wall cabinets and tops of cabinets 72 inches or more above finished floor.
  6. Concealed Surfaces: Any surface not visible after installation.

1.04 QUALITY ASSURANCE
- A. Manufacturer: Minimum of 5 years experience in providing manufactured casework systems for similar types of projects, produce evidence of financial

stability (if requested), bonding capacity, and adequate facilities and personnel required to perform on this project.

B. Manufacturer: Provide products certified as meeting or exceeding ANSI-A 161.1-2000 testing standards.

C. Single Source Manufacturer: Casework, countertops and architectural millwork products must all be engineered and built by a single source manufacturer in order to ensure consistency and quality for these related products. Splitting casework, countertops and/or architectural millwork between multiple manufacturers will not be permitted.

D. Quality Standard: Unless otherwise indicated, comply with AWI's Architectural Woodwork Quality Standards for grades of interior architectural woodwork, construction, finishes and other requirements.

1.05 SUBMITTALS

A. Comply with Special Conditions, unless otherwise indicated.

B. Product Data: Manufacturer's catalog with specifications and construction details.

C. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.

1. Include section drawings of typical and special casework, work surfaces and accessories.
2. Indicate locations of plumbing and electrical service field connection by others.
3. Provide one set of shop drawings which includes all products within this section, engineered and built by a single source manufacturer, with seamless coordination amongst all products.

D. Casework Samples (To be available upon request):

1. Base cabinet: Cabinet conforming to specifications, with drawer and door.
2. Wall cabinet: Cabinet conforming to specifications, with door.
3. Cabinet samples shall be complete with specified hardware for doors, drawers and shelves.
4. Component samples: Two sets of samples for each of the following:

a. Decorative laminate color charts / PVC and ABS edgings.

1.06 PRODUCT HANDLING

A. Deliver completed laminate clad casework, countertops, and related products only after wet operations in building are completed, store in ventilated place, protected from the weather, with relative humidity range of 25 percent to 55 percent.

B. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

1.07 JOB CONDITIONS

A. Environmental Requirements: Do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least 1 week.

1. Manufacturer/Supplier shall advise Contractor of temperature and humidity requirements for architectural casework installation areas.
2. After installation, control temperature and humidity to maintain relative humidity between 25 percent and 55 percent.

B. Conditions: Do not install casework until interior concrete work, masonry, plastering and other wet operations are complete.

1.08 WARRANTY

A. All materials and workmanship covered by this section will carry a five (5) year warranty from date of acceptance.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Manufacturer – Basis for Design:

1. TMI Systems Corporation.
   a. Specifications are based on manufacturer’s literature from TMI SYSTEMS CORPORATION, 50 South Third Avenue West, Dickinson, North Dakota, 58601, Phone: 800-456-6716, fixed modular, flexible rail mounted, and mobile casework and accessories.

b. Other manufacturers shall comply with the minimum levels of material and detailing indicated on the drawings or as specified.

2.02 MATERIALS

A. Core Materials:
   1. Particleboard up to 7/8 inch thick: Industrial Grade average 45-pound density particleboard, ANSI A 208.1-2009, M-2 requirements.
   2. Particleboard 1 inch thick and thicker: Industrial Grade average 45-pound density particle-board, ANSI A 208.1-2009, M-2 requirements.
   3. Medium Density Fiberboard 1/4 inch thick: Minimum average density 45-50 lbs., ANSI A208.2-2009 requirements.
   4. MR Moisture Resistant Particleboard: Average 45-pound density particleboard, ANSI A208.1 1-2009, M-2 requirements.
   5. Toe Base Plywood: 3/4 inch thickness, CC/CD/CDC grades, of western softwood veneers, with NAUF exterior fully water resistant phenolic glues.

B. Decorative Laminates: GREENGUARD Indoor Air Quality Certified
   1. High-pressure decorative laminate VGS (.028), NEMA Test LD 3-2005.
   2. High-pressure decorative laminate HGS (.048), NEMA Test LD 3-2005.
   3. High-pressure decorative laminate HGP (.039), NEMA Test LD 3-2005.
   4. High-pressure cabinet liner CLS (.020), NEMA Test LD 3-2005.
   5. High-pressure backer BKH (.048), (.039), (.028), NEMA Test LD3-2005.
   6. Thermally fused melamine TFM laminate, NEMA Test LD 3-2005. (TFM allowed on casework interiors only, as specified below. Utilization of TFM on any exterior casework surfaces, including door and drawer faces and finished ends, will not be permitted.)

C. Laminate Color Selection: Maximum 1 color per unit face and 5 colors per project. (See Color Selection in section 3.05).

D. Edging Materials:
   1. 1mm PVC banding, machine applied.

2. 3mm PVC banding, machine applied and machine profiled to 1/8 inch radius.

E. Glass:
Not applicable.

2.03 SPECIALTY ITEMS

A. Support Members:
1. Countertop support brackets: Epoxy powder coated, 11 gauge steel with integral cleat mount opening and wire management opening.
2. Undercounter support frames: Epoxy powder coated.
3. Legs: Epoxy powder coated.

2.04 CABINET HARDWARE

A. Shelf Standard and Supports: KV-256 and KV-255.

B. Drawer and Door Pulls: Chrome, U-shaped wire pulls.

C. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed.

D. Catches: Magnetic, Stanley SF-45 and SP-46. Provide other types required for special conditions.

E. Drawer Slides: Knape and Vogt: KV1284 typical withKV1485 full extension ball bearing tracks.

F. Hinges: Blum Model 170-concealed hinges with 170 degree opening or Grass System 1200 (176 degree opening) self-closing with 1000-80 base plate. Two hinges per door up to 36" and 3 hinges per door up to 48" and 4 per door up to 60" high.

G. Coat Hooks: Provide HangSafe Hooks 6400 Series - flat-profile, hook secured with stainless steel #14 x 2" screws and finishing washers. Provide mounting holes at 16" on center minimum and expansion anchor to walls as recommended by manufacturer. Hooks shall be secured to 1.5" thick x 3.5" tall red oak back board x length required.
1. Quantity: as indicated on the Drawings.
2. Wood Finish: as indicated in the Color Schedule on the Drawings.

H. Grommets: Provide plastic grommets at all penetrations through countertop for cabling, power cords, etc. as indicated on the Drawings.

2.05 FABRICATION:

A. Fabricate casework, countertops and related products to dimensions, profiles, and details shown.

B. All casework panel components must go through a supplemental sizing process after cutting, producing a panel precisely finished in size and square to within 0.010 inches, ensuring strict dimensional quality and structural integrity in the final fabricated product.

C. Cabinet Body Construction:

1. Tops and bottoms are glued and doweled to cabinet sides and internal cabinet components such as fixed horizontals, rails and verticals. Minimum 6 dowels each joint for 24 inch deep cabinets and a minimum of 4 dowels each joint for 12 inch deep cabinets. (Mechanical or metal hardware fasteners joining cabinet top and bottom panels to the sides will not be accepted.)
   a. Tops, bottoms and sides of all cabinets are particleboard core.
2. Cabinet backs: 1/4 inch thick medium density fiberboard panel fully captured by the cabinet top, bottom and side panels. Finish to match cabinet interior. 3/4 inch x 4 inch particleboard rails will be placed behind the back panel at the top and bottom, and doweled to the sides utilizing 10mm hardwood fluted dowels. A third intermediate rail will be included on all cabinets taller than 56 inches. Utilize hot melt glue to further secure back and increase overall strength.
   a. Exposed back on fixed or movable cabinets: 3/4 inch thick particleboard with the exterior surface finished in VGS laminate as selected.
3. Fixed base and tall units have an individual factory-applied base, constructed of 3/4 inch thick plywood. Base is 102mm (nominal 4 inch) high unless otherwise indicated on the drawings.
4. Base units, except sink base units: Full sub-top glued and doweled to cabinet sides. (Mechanical or metal hardware fasteners joining cabinet sub-top panel to the sides will not be accepted.)
   a. Sink base units are provided with open top and a stretcher at the front, attached to

the sides. Back to be split removable access panel.

5. Side panels and vertical dividers shall receive adjustable shelf hardware at 32mm line boring centers. Mount door hinges, drawer slides and pull-out shelves in the line boring for consistent alignment.
6. Exposed and semi exposed edges.
   a. Edging: 1mm PVC machine applied.
7. Adjustable Shelves in Cabinets
   a. Core: Particleboard.
   b. Core Thickness: 3/4 inch up to 30 inches wide, 1 inch over 30 inches wide.
   c. Edge: 1mm PVC on Front Edge Only.
8. Interior finish, units with open Interiors:
   a. Top, bottom, back, sides, horizontal and vertical members, and adjustable shelving faces with TFM Thermally Fused Melamine laminate.
9. Interior finish, units with closed Interiors:
   a. Top, bottom, back, sides, horizontal and vertical members, and adjustable shelving faces with TFM Thermally Fused Melamine laminate.
10. Exposed ends:
    a. Faced with high-pressure decorative VGS laminate. Use of TFM on exposed ends will not be permitted.
11. Wall unit bottom:
    a. Faced with thermally fused melamine laminate.
12. Balanced construction of all laminated panels is mandatory. Unfinished core stock surfaces, even on concealed surfaces (excluding edges), are not permitted.

D. Drawers:
1. Sides, back and sub front: Minimum 1/2 inch thick particleboard, laminated with TFM Thermally Fused Melamine doweled and glued into sides. Top edge banded with 1mm PVC.
2. Drawer bottom: Minimum 1/2 inch thick particleboard laminated with TFM Thermally Fused Melamine, screwed directly to the bottom edges of drawer box.

3. Paper storage drawers: Minimum 3/4 inch thick particleboard sides, back, and sub front laminated with TFM Thermally Fused Melamine. Minimum 1/2 inch thick particleboard drawer bottoms screwed directly to the bottom edges of the drawer box. Provide PVC angle retaining bar at the rear of the drawer.

E. Door/Drawer Fronts:
   1. Core: 3/4 inch thick particleboard.
   2. High-pressure decorative VGS laminate exterior, balanced with high-pressure cabinet liner CLS. Use of TFM on exterior or interior surfaces of door/drawer fronts will not be permitted.
   3. Edges: 3mm PVC, machine applied, external edges and outside corners machine profiled to 1/8 inch radius.
   4. Provide double doors in opening in excess of 24 inches wide.

F. Door Fronts with Glass Insert captured by Retainer Clips (CUSTOM GRADE):
   1. Core: 3/4 inch thick particleboard.
   2. High-pressure decorative VGS laminate exterior, balanced with high-pressure VGS laminate. Use of TFM on exterior or interior surfaces of door fronts will not be permitted.
   3. Edges: 3mm PVC, machine applied, external edges and outside corners machine profiled to 1/8 inch radius.
   4. Provide cutout in door panel resulting in 3-3/8 inch frame. Exposed cutout edge to be finished with 1mm PVC edgebanding.
   5. Notch cutout 3/8 inch x 1/4 inch for glass panel to set into, mounting flush with the back side (interior side) of the door panel. Interior cutout edge to be painted a compatible color to the interior surface.
   6. Glass panel to be captured and held in place utilizing glass retainer clips, screwed in place. Minimum eight clips per glass panel located in the four corners of the cutout.

G. Miscellaneous Shelving (not in Cabinets):
   1. Core material: 1 inch thick particleboard.
   2. High-pressure decorative VGS laminate on both faces.

3. Edges: 3mm PVC, external edges and outside corners machine profiled to 1/8 inch radius.

2.06 ARCHITECTURAL CABINET SOLID SURFACE TOPS (Countertops):

A. Design Load: deflection limited to 1/360.

B. Type of Top: homogeneous solid sheets of filled plastic resin complying with the following:

1. Colors and Patterns: as selected by Architect from manufacturer's full range.

2. Special Features: eased edge treatment.

3. Accessories:

a. Adhesives: for seams and drop edges, Formica Solid Surfacing Seaming Cartridges, 9 ounce, color to blend with sheet material.

4. Fabrication: assemble work at shop and deliver to job ready for installation. Manufacture in largest practical pieces for handling and shipping without seams.

a. Fabricate work square and to required lines.

b. Recess and conceal fasteners connections and reinforcing.

c. Design, construction, and installation: details to allow for expansion and contraction of materials. Properly install material with hairline joints held rigidly in place.

d. Fabricate countertops and vanities with back splash and side splash pieces to profiles and sizes indicated.

e. Fabricate items to profiles shown with connections and supports as indicated or as required for complete installation in accordance with manufacturer's written instruction sand approved submittals.

f. Provide cut-outs for plumbing fixtures and trim, washroom accessories, appliances, and

related items: confirm layout with manufacturer's cut-out templates before beginning work. Round corners of cut-outs and sand edges smooth.

g. Do not exceed manufacturer's recommended unsupported overhang distances.

h. Finish exposed surfaces smooth and polish to low sheen.

i. Radius corners and edges.

j. Tolerances: variations in size or openings shall not exceed +/-1/4".

5. Acceptable manufacturer: Formica Solid Surfacing as manufactured by Formica Group / Fabrications, Cincinnati, Ohio **or approved equal**.

PART 3- EXECUTION

3.01 INSPECTION:

A. The casework contractor must examine the job site and the conditions under which the work under this section is to be performed and notify the building owner in writing of unsatisfactory conditions. Do not proceed with work under this Section until satisfactory conditions have been corrected in a manner acceptable to the installer.

3.02 PREPARATION:

A. Condition casework to average prevailing humidity conditions in installation areas prior to installing.

3.03 INSTALLATION:

A. Erect casework, plumb, level, true and straight with no distortions. Shim as required. Where laminate clad casework abuts other finished work, scribe and cut to accurate fit.

B. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind.

C. Repair minor damage per plastic laminate manufacturer's recommendations.

3.04 CLEANING:

A. Remove and dispose of all packing materials and related construction debris.

B. Clean cabinets inside and out. Wipe off fingerprints, pencil marks, and surface soil etc., in preparation for final cleaning by the building owner.

3.05 COLOR SELECTION:

A. Laminate Color Selection:
   1. Select from the full range of standard Wilsonart® and Formica® stock color charts.
   2. Thermally fused melamine laminate matched to White color.

B. Hardware Color Selection:
   1. Hinge: Select from your choice of epoxy powder coating stock colors matched to White, Beige, Gray, Black and Chrome.
   2. Pulls: Select from design specific finish options available in the TMI Vendor Stock Pull Program.
   3. Miscellaneous Hardware (support brackets, metal components, etc.): Select from your choice of epoxy powder coating stock colors matched to White, Beige, Gray, Black and Chrome.

C. PVC Edge Banding Color Selection:
   1. 3mm PVC: Select from the TMI Vendor Stock PVC Program, including over 200 pattern, woodgrain and solid colors matched to Wilsonart® and Formica® laminates.
   2. 1mm PVC: Select from the TMI Vendor Stock PVC Program, including over 200 pattern, woodgrain and solid colors matched to Wilsonart® and Formica® laminates.

End of Section

DIVISION 7 -THERMAL & MOISTURE PROTECTION

SECTION 07100 - WATERPROOFING

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this section of the work.

1.02 Quality Assurance:
- A. Standards:
  - 1. Federal Specifications:
    - a. SS-C-153B, Cement, Bituminous, Plastic.
    - b. SS-A-701B, Asphalt, Weatherproofing.
    - c. LLL-1-535A, Insulation Board, Thermal.

1.03 Submittals:
- A. Provide submittals in the form of samples, and documentation, to the Architect for review.

Part 2 - Products

2.01 Materials:
- A. Solvent Based Asphalt Water Barrier: FS-SS-A-701B.
- B. Flashing Membrane: 20 mil elastomeric modified sheet vinyl.
- C. Asphalt Plastic Cement: SS-C-153B, Type 1.
- D. Accessories: As recommended by manufacturer.
- E. Protection Board: Insulation Board, FS-LLL-1-535A, Class A.
- F. Vapor Barrier under floor slab: refer to Section 07260 - Vapor Barrier.

Part 3 - Execution

3.01 Installation - Wall Waterproofing:
- A. Location: Apply to all exterior concrete and masonry wall surfaces below grade.
- B. General:
  - 1. Repoint all holes cracks and joints and allow to dry before waterproofing.
  - 2. Do not apply until all surfaces are completely dry and clean. Apply only during favorable weather conditions.
- C. Joint Membrane:
  - 1. Location: Apply to all joints in exterior concrete walls below grade.
  - 2. Embed a strip of flashing membrane in plastic cement. Membrane shall be a minimum of 12" wide.
- D. Water Barrier:
  - 1. Hold 4" down from finish grade line so that at no time is the mastic or membrane exposed to view.
  - 2. Apply two (2) coats to form a membrane water barrier, allowing the first coat to dry before applying the second

coat. Apply in strict accordance with manufacturer's instructions. Do not apply until surfaces are completely dry.

3. Apply in a continuous unbroken film free from pin holes or other surface breaks. Take care to seal around all ties, inserts, anchor slots, conduit, pipes, electrical boxes, etc.

E. Protection:

1. Install protection board over all waterproofing prior to backfilling.
2. All back filling shall be carefully done to protect waterproofing. Repair all damaged areas.

3.02 Under Slab Vapor barrier:

A. Refer to Section 07260 – Vapor Barrier.

End of Section

DIVISION 7 - THERMAL & MOISTURE PROTECTION

SECTION 07150 - DAMPPROOFING

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this section of the work.

1.02 Related Work Specified Elsewhere:
- A. Waterproofing - Section 07100
- B. Sealants - Section 07900

1.03 Quality Assurance
- A. Standards:
  - 1. Federal Specifications:
  - a. SS-C-153B, Cement, Bituminous, Plastic.
  - b. SS-A-701B, Asphalt, Weatherproofing.
  - 2. American Society for Testing and Materials:
    - a: ASTM D-250, Asphalt Saturated Asbestos Felts.

Part 2 - Products

2.01 Materials:
- A. Solvent Based Asphalt Water Barrier: FS-SS-A-701B
- B. Flashing Membrane: 20 mil elastomeric modified sheet vinyl.
- C. Asphalt Plastic Cement: SS-C-153B, Type 1.
- D. Asphalt Saturated Felt: ASTM D-250, Un-perforated,#15.
- E. Accessories: As recommended by manufacturer.

Part 3 - Execution

3.01 Installation - Cavity Wall Dampproofing:
- A. General - Masonry and Concrete:
  - 1. Repoint all holes, cracks and mortar joints and allow to dry before waterproofing and dampproofing.
  - 2. Sweep wall base, including concrete slab, clean of dirt and mortar droppings immediately prior to application of waterproofing and dampproofing cavity walls.
  - 3. Do not apply until all surfaces are completely dry and clean.
  - 4. Do not apply until all surfaces are completely dry and clean.
  - 5. Sight exposed mastic and membrane not allowed.
- B. Wall Base Waterproofing:
  - 1. Location: Apply at base of outer face of concrete walls and outer face of inner wythe at all exterior masonry cavity walls.
  - 2. At intersection of outer face of inner wythe with concrete slab, provide a 2" radius cove built up with asphalt plastic cement.

3. At wall base, embed a strip of plastic flashing in Plastic Cement. Lap all joints 8" minimum and seal with joint sealant. Seal completely around piping, conduit, etc. and provide minimum joints using longest sheets of flashing practicable. Seal all punctures. Top edge of membrane shall be a minimum of 8" above concrete slab, worked into curve of plastic cement cover, down, and outward on concrete slab or steel shelf angle to outer wythe.

C. Cavity Wall Dampproofing:
   1. Apply to outer face of inner wythe masonry cavity walls.
   2. Apply two (2) coats to form a membrane water barrier, allowing the first coat to dry before applying the second coat. Apply in strict accordance with manufacturer's instructions. Do not apply until surfaces are completely dry.
   3. Apply in a continuous unbroken film free from pin holes or other surface breaks. Take care to seal around all masonry ties, inserts, anchor slots, conduit, pipes, electrical boxes, etc.

End of Section

DIVISION 7 - THERMAL & MOISTURE PROTECTION

SECTION 07200 – INSULATION

Part 1 - General

1.01 Work Included:
- A. All materials, labor and services and incidentals necessary for the completion of this section of work.

1.02 Quality Assurance:
- A. Standards:
  - 1. Federal Specifications:
    - a. HH-I-524C, Type IV, Class C, Rigid Insulation.
    - b. ASTM C 665-84, Type 1, Insulation Blankets.
    - c. ASTM D1621, Compressive Strength.
    - d. ASTM E84, Flame Spread and Smoke Developed.
- B. Submittals:
  - 1. Provide submittals in the form of samples, and documentation, to the Architect for review.

1.03 Product Delivery, Storage and Handling:
- A. Rigid insulation board is combustible. During storage and insulation, observe good fire safety practice, including job site housekeeping.

1.04 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.**

Part 2 - Products

2.01 Materials:
- A. Rigid Insulation: FS-HH-I-1972/1, Class 2 Rigid Insulation.
  - 1. Type: Glass fiber reinforced polyisocyanurate core with foil facing each side (glass fiber facing at roof insulation), and a compressive strength of 25 p.s.i. and a maximum water vapor transmission rate of >.03 perm-inch.
    - a. Application: 2 layers of rigid insulation. First layer shall be 2” thick / second layer shall be 2” thick for a total thickness of 4” with a minimum total thermal resistance of R-20, **for installation above metal decking and exterior wall at cavities**. Refer to Drawings.
  - 2. Type: expanded polystyrene insulation.
    - a. Application: 2" thick with a thermal resistance of R-10.4, **for foundation wall perimeter below grade installation only.**
  - 3. Adhesive: as recommended by manufacturer of rigid insulation board.

B. Fibrous Insulation: ASTM C 665-84, Type 1
   1. Type:
      a. 6" thick (approx.) mineral wool or fiberglass fire resistant insulating blanket or batt, with kraft paper facing. Thermal resistance R-19. Refer to Drawings for locations.

Part 3 - Execution

3.01 Installation - Rigid Insulation:

A. Install rigid insulation horizontally against back-up wall, or to roof deck, as shown on the Drawings.

B. Rigid insulation and other components applied to metal decking at membrane roofing shall be fastened with approved fasteners at the rate of 1 per 2 square feet to meet FM I-90 requirements. Refer to Section 07550 for additional information.

C. Install 2 layers of rigid insulation to metal roof deck and at wall cavity. Stagger joints of insulation to provide continuous insulation coverage.

D. Cut insulation by means of a saw, knife, or other sharp tool to fit around obstructions across the wall, such as vents, louvers, pipes and conduit.

E. If mastic adhesive is used to supplement holding the insulation in place, observe label directions.

End of Section

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

SECTION 07260 – VAPOR BARRIER

PART 1 - GENERAL

1.01 Work Included

A. Furnish all labor, materials, services and equipment required in conjunction with or properly incidental to the installation of under-slab vapor barriers described herein and/or as shown on the drawings.

1.02 Related Work

A. Section 03300: Cast-In-Place Concrete.

1.03 Job Conditions

A. Subbase: Smooth and level, free from damaging protrusions that would puncture vapor barrier.

1.04 References

A. ASTM E 1643 - Standard Practice for Installation of Water Vapor Barriers Used in Contact with Earth or Granular Fill Under Concrete Slabs.

B. ASTM E 1745 - Standard Specification for Plastic Water Vapor Barriers Used in Contact with Soil or Granular Fill under Concrete Slabs: Exceeds Class B

C. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.

D. ASTM E 154 – Standard Test Methods for Water Vapor Barriers Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

E. ASTM D 1709 - Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.

F. ASTM F 1249 – Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

G. ACI 302.1R – Vapor barrier component (plastic membrane) not less than 10 inches thick.

1.05 Submittals

A. Submit in accordance with Division 1 requirements.

B. Product Data: Provide manufacturers printed product literature and description, including tests and standards that have been performed on the vapor barrier material.

C. Samples: Submit two, 8 1/2 x 11 inch in size, illustrating the vapor barrier and two (2) 8-1/2-in long sample strips of the joint tape.

D. One each of all accessories that will be used in the installation.

E. Verification by Independent testing labs indicating that materials comply with specified requirements.

F. Certificates: Certify that products of this section meet or exceed specified requirements.

G. Manufacturer's Instructions: Indicate complete installation instructions.

PART 2 - PRODUCTS

2.01 Available Products
- A. Stego Wrap 15 mil Vapor Barrier by Stego Industries, L.L.C.
- B. Perminator™ 15 mil by W.R. Meadows .
- C. Vapor Block 15 (mil) by Raven Industries, Inc.
- D. Moistop Ultra 15 (mil) by Fortifiber Building Systems Group
- E. Viper Vaporcheck II 15 mil by Insulation Solutions, Inc.

2.02 Source Quality Control And Testing
- A. Vapor barrier membrane shall have following properties:
  1. Water Vapor Barrier: Meets or exceeds Class A according to ASTM E 1745.
  2. Water Vapor Transmission Rate: 0.012 grains/ft2/hour or lower according to ASTM E 96.
  3. Water Vapor Permeance: 0.01 perms or lower according to ASTM E 154 Sec. 7 or F 1249 (max.).
  4. Tensile Strength: 45.0 lbf/in according to ASTM E 154 Sec. 9. .
  5. Puncture Resistance: 2200 g according to ASTM D 1709, Method B

2.03 Accessories
- A. Tape:
  1. High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 4".
- B. Pipe Boot:
  1. Construct pipe boots from vapor barrier material and pressure sensitive tape per manufacturer's instructions.

PART 3 - EXECUTION

3.01 Examination
- A. Verify that conditions are acceptable for the placement of the vapor barrier.

3.02 Preparation
- A. Ensure that subsoil is approved by Geotechnical Engineer.
  1. Vapor Barrier shall be installed on top of the aggregate, sand or tamped earth base or carton forms. At carton forms provide a vertical leg down to grade and adhered the vapor barrier to the grade beam at or just below the dirt line. Vapor barrier may be placed either above or beneath any carton form slip sheet.

3.03 Installation

A. Install vapor barrier per manufacturer's instructions, illustrations and ASTM E 1643 Standard Practice for Installation of Water Vapor Barriers Used in Contact with Earth or Granular Fill Under Concrete Slabs.

1. Level and tamp or roll granular base.
2. Place Vapor Barrier with the longest dimension parallel with the direction of the pour.
3. Lap Vapor Barrier over footings and seal to foundation walls. Seal all penetrations.
4. Lap joints 6 inches and seal with the recommended pressure sensitive tape.
5. Seal pipe penetrations with pipe boot made from vapor barrier and tape.
6. Protect vapor barrier from damage during installation of reinforcing steel and utilities.
7. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with pressure sensitive tape.

3.04 Interface With Other Work

A. Coordinate work of all other trades related to the slab base and utility services.

END OF SECTION

DIVISION 7 - THERMAL & MOISTURE PROTECTION

SECTION 07415 – PREFINISHED METAL SOFFIT PANELS

Part 1 - General

1.01 Work Included:
- A. The General Conditions and applicable sections of Division 1 shall apply to this entire section.
- B. All materials, labor, services and incidentals necessary for the completion of this section of the work.

1.02 Related Work Specified Elsewhere:
- A. Metal Fabrications - Section 05500
- B. Flashing and Sheet metal - Section 07600

1.03 Quality Assurance:
- A. Qualifications of Installer: Competent and skilled sheet metal applicator familiar with this type installation with successful completion of projects of familiar scope. Applicator shall have at least two years of experience in prefinished sheet metal applications.

1.04 Shop Drawings:
- 1.1 Submit complete shop drawings on all prefinished metal applications, showing layouts of seams, joints, details, and installation methods. Show details of weatherproofing at edges, terminations and penetrations in metal work.

1.05 Applicator and Guarantee:
- C. All work shall be done by one contractor with 5 years minimum experience in this type of metal work.
- B. Provide ten (10) years guarantee written on contractor's letterhead for work of this Section.

1.06 Warranty:
- A. Provide a 20-year manufacturer's warranty covering color fade, chalk, and film integrity at no charge.

1.07 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.**

Part 2 - Products

2.01 Acceptable Manufacturers:
- A. Quality of Manufacturers: The products, colors and finishes herein are of AEP-Span products to establish standards of quality and appearance. The products of other manufacturers are acceptable subject to meeting or exceeding the requirements of these specifications, and the approval of the Architect.

2.02 Materials -
- A. Prefinished Metal Soffits:
  - 1. Flush Panel, (FP 12-2) 24 gauge steel with embossed finish.

2. Color: to be selected by Architect from Manufacturer's standard colors.
3. Flashings, Closures, and Trim shall be fabricated from same material, gauge, and finish as panels.
4. Finish: Kynar 500.

Part 3 - Execution

3.01 Installation:

A. Fabricate and install prefinished metal facings in accordance with drawings and recognized sheet metal practices using conventional hand or power tools. Keep cut edges sharp, clean, properly dressed and closely aligned. Exercise care during fabrication and erection to avoid damage.

B. Structural framing members and fasteners shall be sized and located as recommended by the panel manufacturer. The applicator shall insure that the correct fastener has been chosen for size and length necessary for loading requirements. Special care shall be exercised installing fasteners so as not to overdrive or misdirect fasteners which could cause damage to panels or trim. Use colored pop rivets on trim items and where exposed fasteners are necessary. Keep exposed fasteners to very minimum.

C. Only minor scratches and abrasions will be allowed to be touched up. Any other damaged material shall be replaced.

End of Section

DIVISION 7 – THERMAL & MOISTURE PROTECTION

SECTION 07424 – COMPOSITE WALL PANELS

PART 1 General

1.1 Work Included:

A. Aluminum-faced composite panels, attachments, and sealants.

1.2 Related Sections:

A. Section 05100 – Structural Metal Framing.

B. Section 06100 – Rough Carpentry.

C. Section 07200 – Insulation

D. Section 07600 – Flashing and Sheet Metal.

E. Section 07900 – Sealants.

F. Section 09250 – Gypsum Wallboard.

1.3 References:

A. American Society for Testing and Materials (ASTM) B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

B. American Society for Testing and Materials (ASTM) C481 - Laboratory Aging of Sandwich Constructions.

C. American Society for Testing and Materials (ASTM) E72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.

D. American Society for Testing and Materials (ASTM) E84 - Surface Burning Characteristics of Building Materials.

E. American Society for Testing and Materials (ASTM) E283 - Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors.

F. American Society for Testing and Materials (ASTM) E289 - Linear Thermal Expansion of Rigid Solids with Interferometry.

G. American Society for Testing and Materials (ASTM) E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors.

H. American Society for Testing and Materials (ASTM)

E331 - Water Penetration for Exterior Windows, Curtain Walls, and Doors.

I. American Society for Testing and Materials (ASTM) D1781 - Climbing Drum Peel for Adhesives.

J. American Society for Testing and Materials (ASTM) - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

K. American Architectural Manufacturers Association (AAMA) 501 – Water Penetration using Dynamic Pressure.

L. American Architectural Manufacturers Association (AAMA) 605.2 - Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.

M. American Architectural Manufacturers Association (AAMA) TIR-a11 - Maximum Allowable Deflection of Framing Systems for Building Cladding Components at Design Wind Loads.

1.4 System Description:

A. Design Requirements:
   1. Design system to accommodate movement of components without buckling, failure of joint seals, undue stress on fasteners, or other detrimental effects when subjected to temperature and humidity ranges reasonably anticipated.
   2. Design system to accommodate tolerances of structure.

B. Performance Requirements:
   1. Submit test data witnessed by an independent testing agency for the following requirements:
      a. Structural tests for wind loads by "Chamber Method" in compliance with ASTM E72.
         1) Standard test design loading: 20 psf (960 Pa) positive and negative wind load.
         2) Design panel system to withstand code imposed design loads and a deflection limit of L/180 shall apply to positive

load pressures only.

3) Design panel system to withstand code imposed design loads and a deflection limit of L/175 shall apply to positive load pressures only.

b. Air Infiltration: 0.06 cfm per square foot (32 lps per square meter) air leakage under a static pressure of 1.56 psf (7.65 kg per square meter) when tested in accordance with ASTM E283.

c. Water Penetration: No uncontrolled water penetration through the standard vertical panel and sealed joints at a static pressure of 6.24 psf (30.5 kg per square meter) when tested in accordance with ASTM E331.

1.5 Submittals:

A. Submit as directed below and as per the Special Conditions.

B. Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Submit shop drawings showing layout, flashings, drainage, ventilation, vapor barriers, vapor retarders, profiles and product components, including anchorage, accessories, finish colors, patterns, and textures.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 3 inches (76 mm) by 5 inches (128 mm) representing actual product, color, and patterns.

F. Quality Assurance Submittals: Submit the following:
1. Test reports: Certified test reports showing

compliance with specified performance characteristics and physical properties.

2. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria, and physical requirements.

1.6 Quality Assurance:

A. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction, approving acceptable installer and approving application method.

B. Installer Qualifications:
   1. Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
   2. Panel Installer shall assume responsibility for all components of the exterior panel system including, but not limited to attachment to sub-construction, panel to panel joinery, panel to dissimilar material joinery, and joint seal associated with the panel system.

C. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

1.7 Delivery, Storage, and Handling:

A. Store panels horizontally, off-the-ground, in manufacturer's unopened packaging until ready for installation.

B. Examine delivered materials upon receipt to ensure that no damage has occurred during shipment. Store metal-faced composite wall panels horizontally, covered with a suitable weather tight and ventilated covering. Store metal-faced composite wall panels to ensure dryness, with a positive slope for drainage of water. Do not store metal-faced composite wall panels in contact with other materials that might cause staining, denting, or other surface damage. DO NOT allow storage space

to exceed 120 degrees F (49 degrees C).

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

1.8 Project Conditions:

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 Warranty:

A. Finish Warranty: Commencing on Date of Substantial Completion.
   1. Provide 20-year written warranty with PVDF/KYNAR 500 finish color coated metal finish covering color fading, chalking, and film integrity.
   2. Finish coating shall not peel, blister, chip, crack or check.
   3. Chalking, fading or erosion of finish measured by the following tests:
      a. Finish coating shall not chalk in excess of 8 numerical ratings when measured in accordance with ASTM D659.
      b. Finish coating shall not change color or fade in excess of 8 NBS units as determined by ASTM D2244.

B. Material and Installation Warranty: Commencing on Date of Substantial Completion.
   1. When installed as directed by Laminators Incorporated, panels covered by this warranty are warranted not to delaminate (separate) at any Laminators produced glue line for a period of five years.

PART 2 PRODUCTS

2.1 Manufacturers:

A. Acceptable Manufacturer: Laminators Incorporated; 3255 Penn St., Hatfield, PA 19440. ASD. Tel:

(215)723-8107. Toll Free: (877) OMEGA77. Fax: (215) 721-1239. Web: http://www.laminatorsinc.com

B. Substitutions: as approved by Architect.

C. Requests for substitutions will be considered in accordance with provisions of the Project Manual.

2.2 Omega-Lite Aluminum-Faced Composite Panels:

A. Omega-Lite Composite Panels as manufactured by Laminators Incorporated.
   1. Panel Construction: Finished aluminum sheet over a corrugated polyallomer (CPA) core with backer sheet.
   2. Panel Facing:
      a. Smooth face, minimum 0.021 inch (0.53 mm) thick, ASTM B209 aluminum sheet
   3. Panel Backing:
      a. Random painted aluminum sheet, minimum 0.013 inch (0.33 mm) thick, ASTM B209 aluminum sheet
   4. Panel Thickness: 6 mm (1/4 inch)
   5. Fire Test Performance: ASTM E84: Class A.
   6. Bond Test Performance: ASTM C481-A Cyclic Aging: Pass.
   7. Finish:
      a. PVDF/Kynar 500 – 20-year warranty paint system meeting AAMA 2605
   8. Finish Colors: Refer Room Finish Schedule included in the Drawings.

B. Aluminum Composite Panel Installation System:
   1. Installation:
      a. 1-Piece Tight-Fit Extrusion (6 mm only)
      b. Reveal "H"-Molding 4595X
      c. Provide corner, drip edge, etc. trim as required for complete and watertight installation.

2.3 Accessories:

A. Manufacturer's Sealants and Accessories: Provide manufacturer's recommended sealants and accessories for product installation.

B. Flashing: Fabricate flashing materials from 0.030 inch (0.76 mm) minimum thickness aluminum sheet

painted to match the adjacent curtain wall/panel system where exposed. Provide a 12 inch (305 mm) wide lap strap under the flashing at abutted conditions and seal lapped surfaces with a full bed of non-hardening sealant.

2.4 Fabrication:

A. Panels shall be fabricated and finished as required to provide material construction and performance as specified and as required by manufacturer to comply with warranty provisions.
   1. Tolerances: Length and Width: plus or minus 1/16 inch (1.6mm). Squareness (Diagonals): equal within 1/8 inch (3.2mm).

PART 3 EXECUTION

3.1 Examination:

A. Do not begin installation until substrates have been properly prepared.

B. Examine substrates, areas, and conditions, with substrate installer present, for compliance with requirements for structural soundness, installation tolerances, metal panel supports, and other conditions affecting performance of work.
   1. Examine primary and secondary wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances listed below.
      a. 1/4 inch (6 mm) in any 20 feet (6 m) length vertically or horizontally.
      b. 1/2 inch (12 mm) in any building elevation.
   2. Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required.
   3. For the record, prepare written report, endorsed by panel installer and substrate installer, listing remedy for conditions detrimental to performance of work.

C. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal

panels before metal panel installation.

D. Proceed with installation only after all unsatisfactory conditions have been corrected.

E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 Installation:

A. Comply with manufacturer's installation guides and Product Data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation type selected.

B. Work shall be done and completed in a thorough and workmanlike manner by mechanics skilled in their various trades.

C. Caulk Installation:
1. Use only approved sealants as described in Laminators Incorporated Installation Guidelines.
2. The sealant manufacturer’s instructions shall be followed in preparing and installing sealants.
3. Joints to receive sealant shall be clean, dry and free from dust, grit and contaminants.
4. The sealant shall completely fill the glazing pockets.

3.3 Field Quality Control:

A. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.

3.4 Cleaning and Protection:

A. Protection: Protect installed product and finish surfaces from damage during construction.

B. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or

replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

C. Protect installed products until completion of project.

D. Touch-up, repair or replace damaged products before Substantial Completion.

End of Section

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

SECTION 07550 – MODIFIED BITUMEN MEMBRANE ROOFING SYSTEM

Part 1 - General

1.01 Section Includes:
- A. Preparation of Substrate to Receive Roofing Materials
- B. Roof Insulation Application to Prepared Substrate
- C. Roof Membrane Application
- D. Roof Flashing Application
- E. Incorporation of Sheet Metal Flashing Components and Roofing Accessories into the Roof System

1.02 Products Installed But Not Furnished Under This Section:
- A. Sheet Metal Flashing and Trim
- B. Sheet Metal Roofing Specialties

1.03 Related Sections:
- A. Roof Decks - Section 05310
- B. Rough Carpentry - Section 06100
- C. Insulation - Section 07200
- D. Flashing & Sheet Metal Section 07600

1.04 Reference Standards:

References in these specifications to standards, test methods and codes, are implied to mean the latest edition of each such standard adopted. The following is an abbreviated list of associations, institutions, and societies which may be used as references throughout these specifications.

ASTM	American Society for Testing and Materials Philadelphia, PA
FM	Factory Mutual Engineering and Research Norwood, MA
NRCA	National Roofing Contractors Association Rosemont, IL
OSHA	Occupational Safety and Health Administration Washington, DC
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Chantilly, VA
UL	Underwriters Laboratories, Northbrook, IL

1.05 Description Of Work:
- A. **Project Type:** New installation.
  Deck: Metal Slope: **3/8 inch ±** per foot.
- B. **Rigid Insulation:**
  1. Top and Bottom Layers: Polyisocyanurate, having a total thickness of **4"** – top layer of 2" and bottom layer of 2”. Refer to Section 07200, Insulation.
  2. Crickets: Polyisocyanurate (tapered) providing a roof slope to roof drains (refer to Drawings.)
- C. **Gypsum sheathing panel:** having a thickness of 1/2 inch, mechanically attached, as per FM I-90 requirements.
- D. **Roof System:** Modified Bitumen Base, applied in cold adhesive; stripping and Flashing, applied in cold adhesive.

Modified Bitumen Finish Ply applied in cold adhesive.

E. **Flashing System:** SBS with continuous metal-foil surfacing, torch applied.

1.06 Submittals:

A. Submittals Prior to Contract Award:

1. Letter from the proposed primary roofing manufacturer confirming that the bidder is an acceptable Contractor authorized to install the proposed system.
2. Letter from the primary roofing manufacturer stating that the proposed application will comply with the manufacturer's requirements in order to qualify the project for the specified guarantee.

B. Submittals Prior to Project Close-out:

1. Manufacturer's printed recommendations for proper maintenance of the specified roof system including inspection frequencies, penetration addition policies, temporary repairs, and leak call procedures.

1.07 Quality Assurance:

A. Acceptable Products: Primary roofing products, including each type of sheet, all manufactured in the United States, shall be supplied by a single manufacturer which has been successfully producing the specified types of primary products for not less than 10 years. The primary roofing products shall have maintained a consistent composition for a minimum of five years.

B. Agency Approvals: The proposed roof system shall conform to the following requirements. No other testing agency approvals will be accepted.

1. Underwriters Laboratories Class A acceptance of the proposed roofing system without additional requirements for coatings.

C. Acceptable Contractor: Contractor shall have a minimum of 10 years of experience in successfully installing the same or similar roofing materials and be certified in writing by the roofing materials manufacturer to install the primary roofing products for a minimum of 5 years prior to the date of bid opening.

1. Torch Applicators: Contractor shall employ torch applicators who have successfully passed the CERTA (Certified Roofing Torch Applicator) program requirements as provided by the National Roofing Contractors Association (NRCA).
2. The Contractor shall have an office, warehouse with supplies, and permanent roofing crews within a 50 mile radius of Moore, Oklahoma. Contractor shall have had "NDL" (No Dollar Limit) approval for 5 years AT THIS AREA OFFICE from manufacturer and shall perform a

minimum of ten (10) NDL manufacturer guarantees per year.

3. **Owner's Roofing Contractor (Universal Roofing and Sheet Metal located in Moore, Oklahoma) shall be utilized on this project. The bid shall be based on the provided drawings, specifications, and agreed-to pricing.**

D. Scope of Work: The work to be performed under this specification shall include but is not limited to the following: Attend necessary job meetings and furnish competent and full-time supervision, experienced roof mechanics, all materials, tools, and equipment necessary to complete, in an acceptable manner, the roof installation in accordance with this specification. Comply with the latest written application instructions of the manufacturer of the primary roofing products. In addition, application practice shall comply with requirements and recommendations contained in the latest edition of the Handbook of Accepted Roofing Knowledge (HARK) as published by the National Roofing Contractors Association, amended to include the acceptance of a phased roof system installation.

E. Local Regulations: Conform to regulations of public agencies, including any specific requirements of the city and/or state of jurisdiction.

F. Manufacturer Requirements: Ensure that the primary roofing materials manufacturer provides direct trained company personnel to attend necessary job meetings, perform periodic inspections as necessary, and conducts a final inspection upon successful completion of the project.

G. Contractor shall have one of the following approved Contractor Certification levels prior to bid opening:
   Johns Manville - Peak Advantage Contractor
   Soprema – Soprema Certified Applicator
   Siplast – Siplast Select Applicator
   GAF - Master Select Contractor

1.08 Product Delivery Storage And Handling:

A. Delivery: Deliver materials in the manufacturer's original sealed and labeled containers and in quantities required to allow continuity of application.

B. Storage: Store materials out of direct exposure to the elements. Store roll goods on a clean, flat and dry surface. All material stored on the roof overnight shall be stored on pallets. Rolls of roofing must be stored on ends. Store materials on the roof in a manner so as to preclude overloading of deck and building structure. Store materials such as solvents, adhesives, and asphalt cutback products away from open flames, sparks, or excessive heat.

Cover all material using a breathable cover such as a canvas. Polyethylene or other non-breathable plastic coverings are not acceptable.

C. Handling: Handle all materials in such a manner as to preclude damage and contamination with moisture or foreign matter. Handle rolled goods to prevent damage to edges or ends.

D. Damaged Material: Any materials that are found to be damaged or stored in any manner other than stated above will be automatically rejected, removed, and replaced at the Contractor's expense.

1.09 Project/Site Conditions:

A. Requirements Prior to Job Start

1. Notification: Give a minimum of 5 days notice to the Owner and manufacturer prior to commencing any work and notify both parties on a daily basis of any change in work schedule.
2. Permits: Obtain all permits required by local agencies and pay all fees which may be required for the performance of the work.
3. Safety: Familiarize every member of the application crew with all fire and safety regulations recommended by OSHA, NRCA and other industry or local governmental groups.

B. Environmental Requirements:

1. Precipitation: Do not apply roofing materials during precipitation or in the event there is a probability of precipitation during application.
   Take adequate precautions to ensure that materials, applied roofing, and building interiors are protected from possible moisture damage or contamination.
2. Temperature Restrictions: At ambient temperatures between 40F and 50F, prepare / warm adhesive as directed by manufacturer.

C. Protection Requirements:

1. Membrane Protection: Provide protection against staining and mechanical damage for newly applied roofing and adjacent surfaces throughout this project.
2. Torch Safety: Designate one person on each crew to perform a daily fire watch. The designated crew member shall watch for fires or smoldering materials on all areas of roof construction. Continue the fire watch after roofing material application has been suspended for the day.
3. Limited Access: Prevent access by the public to materials, tools, and equipment during the course of the project.

4. Debris Removal: Remove all debris daily from the project site and take to a legal dumping area authorized to receive such materials.
5. Site Condition: Complete, to the owner's satisfaction, all job site clean-up including building interior, exterior and landscaping where affected by the construction.

1.10 Guarantee/Warranty:

A. Roof Membrane Guarantee: Upon successful completion of the project, and after all post installation procedures have been completed, furnish the Owner with **the manufacturer's ten year labor and materials membrane guarantee.** The guarantee shall be a term type, without deductibles or limitations on coverage amount, and shall be issued at no additional cost to the Owner. This guarantee shall not exclude random areas of ponding from coverage.

1.11 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Only the four systems listed in 2.02 Description of Systems below will be accepted for installation on this project.**

Part 2 - Products:

2.01 Roofing System Assembly/Products:

A. Rigid Roof Insulation: Roof insulation shall be UL and FM approved. Insulation shall be approved in writing by the insulation manufacturer for intended use and for use with the specified roof assembly. Refer to Section 07200.

B. Recover Board Sheathing Panel for Roof Membrane Substrate: A panel composed of high density fiberboard, non-structural water resistant core material integrally bonded having a nominal thickness of 1/2 inch.
   1. Acceptable Manufacturer: Fiberboard Coated High Density Roof Insulation, by Huebert.

C. Gypsum Sheathing Panel for Wood/Plywood Surfaces to Receive Flashing Coverage: A panel composed of a gypsum based, non-structural water resistant core material integrally bonded with fiberglass mats on both sides having a nominal thickness of 1/2 inch. The panel surface shall be factory primed with a non-asphaltic primer.
   1. Acceptable Manufacturer: DensDeck Prime Gypsum Roof Board, by Georgia Pacific Corporation; Atlanta, GA

2.02 Description Of Systems:

A. Roofing Membrane Assembly: A roof membrane assembly consisting of two plies of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, applied over a prepared

substrate. Both reinforcement mats shall be impregnated/saturated and coated each side with an SBS modified bitumen blend. The roof system shall pass 500 cycles of ASTM D 5849 Resistance to Cyclic Joint Displacement (fatigue) at 14F - or show evidence of other independent testing indicating resistance fatigue, membrane cracking and delamination. Passing results shall show no signs of membrane cracking or interply delamination after 500 cycles. The roof system shall pass 200 cycles of ASTM D 5849 after heat conditioning performed in accordance with ASTM D 5147. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system.

1. Acceptable Manufacturer: Johns Manville roof system:
   a. Modified Bitumen Base, Stripping, and Flashing Reinforcing Ply.
      JM DynaBase
   b. Modified Bitumen Finish Ply
      JM DynaGlas FR
   c. Stripping Ply and Flashing Reinforcing Sheet
      JM DynaPly

B. Flashing Membrane Assembly: A flashing membrane assembly consisting of a prefabricated, reinforced, Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane with a continuous, channel-embossed metal-foil surfacing. The finish ply shall conform to ASTM D 6298 and the following physical and mechanical property requirements.

1. Acceptable Manufacturer: Johns Manville flashing system, aluminum finish
   a. Cant Backing Sheet for Wood/Plywood Surfaces to Receive Flashing Coverage: applicable JM product.
   b. Metal-Clad Modified Bitumen Flashing Sheet: JM DynaClad Flashing
   c. Cant Strip: JM FesCant Plus Cant Strips

C. Catalyzed Acrylic Resin Flashing System: A specialty flashing system consisting of a liquid-applied, fully reinforced, multi-component acrylic membrane installed over a prepared or primed substrate. The flashing system consists of a catalyzed acrylic resin primer, basecoat and topcoat, combined with a non-woven polyester fleece. The resin and catalyst are pre-mixed immediately prior to installation. The use of the specialty flashing system shall be specifically approved in advance by the membrane manufacturer for each application.

1. Acceptable Manufacturer: Flashing System by Johns Manville; Denver, CO

D. Additional Roof Systems: The following additional roof systems are acceptable for use in lieu of the specified roof system.

1. GAF Materials Corp., Wayne, NJ
   Base Ply B Ruberoid Mop Smooth
   Finish Ply B Ruberoid Mop FR - cap ply Plus
   Flashing Sheet B Ruberoid Ultraclad SBS
   Stripping Ply and Flashing Reinforcing Sheet - Ruberoid Mop Smooth
2. Soprema, Inc., Wadsworth, OH
   Base Ply – Elastophene Sanded 2.2
   Finish Ply – Elastophene LS FR GR
   Flashing Sheet – Sopralast 50 TV ALU
   Stripping Ply and Flashing Reinforcing Sheet - Elastophene Sanded 2.2

2.03 Roofing Accessories:

A. Roofing Adhesives:
   1. Membrane Cold Adhesive: An asphalt, solvent blend conforming to ASTM D 3019, Type III requirements.
      a. Acceptable Manufacturer: MBR Cold Application Adhesive by Johns Manville; Denver, CO

B. Bituminous Cutback Materials:
   1. Primer: An asphalt, solvent blend conforming to ASTM D 41 requirements.
   2. Mastics: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges conforming to ASTM D 4586 Type II requirements.

C. Sealant: A moisture-curing, non-slump elastomeric sealant designed for roofing applications. The sealant shall be approved by the roof membrane manufacturer for use in conjunction with the roof membrane materials.

D. Ceramic Granules: No. 11 grade specification ceramic granules of color scheme matching the granule surfacing of the finish ply.

E. Metallic Powder: A finely graded metal dust as supplied or approved by the membrane manufacturer, used for covering of bitumen overruns over the foil surfaced membrane.

F. Perlite Cant Strips: A cant strip composed of expanded volcanic minerals combined with waterproofing binders. The top surface shall be pre-treated with an asphalt based coating. The face of the cant shall have a nominal 4 inch dimension.

G. Fasteners:

1. Gypsum Sheathing Panel Fasteners for Roofing Substrates and Wood/Plywood Flashing Surfaces: Gypsum sheathing panel fasteners and plates shall be FM Approved, and/or approved by the manufacturer of the primary roofing products. The fastening pattern for each panel to be used shall be as recommended by the panel manufacturer and approved by the manufacturer of the primary roofing products. Acceptable panel fastener manufacturers for specific substrate types are listed below.
   a. Wood/Plywood Flashing Surfaces: Gypsum sheathing panel mechanical fasteners shall be factory coated for corrosion resistance. The fastener shall conform meet or exceed Factory Mutual Standard 4470 and when subjected to 30 Kesternich cycles, show less than 15% red rust. Acceptable fastener types for wood/plywood substrates are listed below.
      1) A fluorocarbon coated screw type roofing fastener having a minimum 0.220 inch thread diameter. Plates used in conjunction with the fastener shall be a metal type having a minimum 3 inch diameter, as supplied by the fastener manufacturer.
   b. Acceptable Manufacturer=s:
      1) Ultrafast Fastener with UltraFast Round Metal Plates by Johns Manville; Denver, CO
      2) Dekfast #12 with Dekfast Steel Hexagonal Plates by Construction Fasteners, Inc.; Wyomissing, PA
      3) Standard Roofing Fastener by Olympic Manufacturing Group, Agawam; MA
2. Flashing Reinforcing Sheet Fasteners: Fasteners shall be approved by the manufacturer of the primary roofing products. Acceptable fasteners for specific substrate types are listed below.
   a. Wood/Plywood Substrates
      1) A 12 gauge, spiral or annular threaded shank, zinc coated steel roofing fastener having a minimum 1 inch head.
      2) Square Cap by W.H. Maze Co.; Peru, IL
         12 Gauge Simplex Nail by the Simplex Nail and Manufacturing Co., Americus, GA
      3) Fasteners shall be applied to meet FM-I90 requirements. At crickets, if insulation

thickness prohibits satisfactory application of fasteners, use adhesive similar to Para-STIK insulation adhesive.

H. Walktread: A prefabricated, puncture resistant polyester core reinforced, polymer modified bitumen sheet material topped with a ceramic-coated granule wearing surface.
   1. Thickness: 0.25 in
   2. Width: 32 in
   3. Acceptable Manufacturer: DynaTred Roof Walkway Pads by Johns Manville; Denver, CO

I. Pipe Supports Typical:
   1. Roller System: A Aroller-bearing@ pipe support for roof-mounted gas pipes, RTU condensate lines, and electrical conduit up to 4" I.D. or 5"O.D. Pipes rest on a self-lubricating roller system which is made of a stainless steel or glass-filled nylon rod and a sturdy polycarbonate resin roller. Pipe support base shall be manufactured of polycarbonate resin with a roller rod of glass-filled nylon, and stainless steel metal parts.
   2. Load Weight: Maximum load weight may not exceed 125 lbs. per pipestand.
   3. Spacing: Not to exceed 10 foot centers. Do not exceed 125 lbs. load weight and adjust pipe stand in height to even load.
   4. Acceptable Manufacturer: Pillow Block Pipestand Model 4-R, Miro Industries, Inc., 1780 West 2300 South, Salt Lake City, Utah 84119.

J. Pipe Supports at Turns In Large Piping:
   1. Pipe Support Hangers: A Aclevis hanger@ pipe support hanger for roof mounted gas pipes at all large (over 4" I.D.) piping corners, bends, and Atees@/pipe intersections. Pipes rest on a clevis hanger with a support base of stainless steel polycarbonate. All other metal parts are hot-dip galvanized steel.
   2. Load Weight: Maximum load weight not to exceed 310 lbs. per pipestand or 155 lbs. on each base.
   3. Spacing: Locate Aclevis@ type pipe hangers at all corners, bends, and Atees@/pipe intersections not to exceed 10'-0" o.c. maximum. Do not exceed 310 lbs. load weight (155 lbs. on each base) and make certain each pipestand is adjusted in height to even load at all pipestands.
   4. Acceptable Manufacturer: Pillow Block Pipestand Model 6-H, Miro Industries, Inc., 1780 West 2300 South, Salt Lake City, Utah 84119.

K. Penetration Dam/Sealer Pockets shall be similar to: **ChemCurb System:** gray polyester resin exterior forms, structural sealant and One (1) part self-leveling moisture cure pourable sealer (gray).

Part 3- Execution

3.01 Preparation:

A. General: Sweep or vacuum all surfaces, removing all loose aggregate and foreign substances prior to commencement of roofing.

3.02 Substrate Preparation - Metal Deck / Insulation:

A. Preparation of Wood/Plywood Substrates to Receive Flashing Materials: Mechanically attach the gypsum sheathing panels to all wood/plywood substrates that will be covered with the specified flashing membrane, using the specified screws/plates, at 12 inches o.c. staggered. Cut the cant backing sheet into 12 inch widths and peel the release film from the back of the sheet. Set the sheet into place extending 6 inches onto the field of the roof area and 6 inches up the gypsum sheathing panel surface utilizing minimum 3 inch side laps. Set the cant into place prior to installation of the roof membrane base ply.

B. Insulation Panel - two layers: Mechanically attach the insulation panels, using the specified fasteners, at a rate of 1 fastener for every 2.7 square feet of panel area (12 per 4' x 8' panel). Increase the fastening frequency by 50% at the perimeter of the roof area and by 75% at the corners. Meet FM I-90 requirements.

C. Gypsum Sheathing Panels: Install sheathing panels, and any tapered insulation in hot asphalt, with end joints offset; edges of the panels shall be in moderate contact without forcing applied in strict accordance with the insulation manufacturer's requirements and the following instructions.

3.03 Roof Membrane Installation:

A. Membrane Application: Apply roofing in accordance with roofing system manufacturer's instructions and the following requirements. Application of roofing membrane components shall immediately follow application of base sheet and/or insulation as a continuous operation.

B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this project. Make necessary preparations, utilize recommended application techniques, apply the specified materials including granules and metallic powder, and exercise care in ensuring that the finished application is acceptable to the Owner.

C. Priming: Prime metal and concrete and masonry surfaces with a uniform coating of the specified primer.

D. Membrane Adhesive Application: Membrane adhesive can be applied by roller, squeegee or spray unit. Apply cold adhesive in a smooth, even, continuous layer without breaks or voids. Utilize an application rate of 2 to 2 1/2 gal/sq over irregular or porous substrates. Utilize an application rate of 1 1/2 to 2 gal/sq for interply applications. Double the adhesive application rate at the end laps of granule surfaced sheets. In the areas surrounding details that are to receive the catalyzed acrylic resin primer and flashing system, apply membrane plies in a full coating of the specified elastomeric sealant in lieu of the solvent based adhesive a minimum 8 inches from the base of the penetration or curb.

E. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.

F. Roofing Application: Apply all layers of roofing free of wrinkles, creases, or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets.

1. Apply all layers of roofing perpendicular to the slope of the deck.
2. Fully bond the base ply to the prepared substrate, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the asphalt applicator. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger end laps a minimum of 3 feet.
3. Fully bond the finish ply to the base ply, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the cold adhesive applicator. Stagger end laps of the finish ply a minimum 3 feet. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger side laps of the finish ply a minimum 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum 3 feet from end laps in the underlying base ply.
4. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall

provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes.

G. Granule Embedment: Broadcast mineral granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot or the adhesive is soft, to ensure a monolithic surface color.

H. Flashing Application - masonry surfaces: Flash masonry parapet walls and curbs using the reinforcing sheet and the metal foil flashing membrane. After the base ply has been applied to the top of the cant, fully adhere the reinforcing sheet, utilizing minimum 3 inch side laps and extend a minimum of 3 inches onto the base ply surface and 3 inches up the parapet wall above the cant. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or by application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three foot widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the metal foil flashing layer from lap seams in the reinforcing layer. Extend the flashing sheet a minimum of 4 inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on 9 inch centers. (See manufacturer's schematic for visual interpretation).

I. Flashing Application B surfaces sheathed with gypsum sheathing panels: After the gypsum sheathing panel and cant backing sheet have been installed, flash parapet walls and curbs with the specified reinforcing sheet and the metal foil flashing membrane. The reinforcing sheet shall have minimum 3 inch side laps and extend a minimum of 3 inches onto the base ply surface and to the top of the parapet wall or curb. Using the specified fasteners, mechanically attach the reinforcing sheet through the field of the sheet to the vertical flashing surface on 12 inch centers from the top of the cant to the top of the wall or curb. Fully adhere the remainder of the flashing reinforcing sheet that extends over the cant and roof level. Using a Leister Hand Welding Tool, seal the laps

between flashing reinforcing sheets. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or by application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three foot widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the metal foil flashing layer from lap seams in the reinforcing layer. Extend the flashing sheet a minimum of 4 inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on 9 inch centers. (See manufacturer's schematic for visual interpretation).

J. Catalyzed Acrylic Resin Flashing System: Install the liquid-applied primer and flashing system in accordance with the membrane system manufacturer=s printed installer=s guidelines and other applicable written recommendations as provided by the manufacturer.

K. Use of Metallic Powder: Broadcast metallic powder over all bitumen overruns on the metal foil membrane surface while the bitumen is still hot to ensure a monolithic surface color.

L. Water Cut-Off: At end of day's work, or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to the resumption of roofing.

3.04 Roof System Interface With Related Components:

A. Walktread: Cut the walktread into maximum 5 foot lengths and allow to relax until flat. Adhere the sheet using the specified plastic cement. Apply the specified cement in a 3/8 inch thickness to the back of the product in 5 inch by 5 inch spots in accordance with the pattern as supplied by the walktread manufacturer. Walk-in each sheet after application to ensure proper adhesion. Use a minimum spacing of 2 inches between sheets to allow for proper drainage.

B. Sealant: Apply a smooth continuous bead of the specified sealant at the exposed finish ply edge transition to metal

flashings incorporated into the roof system.

3.05 Field Quality Control And Inspections:

A. Site Condition: Leave all areas around job site free of debris, roofing materials, equipment, and related items after completion of job.

B. Notification Of Completion: Notify the manufacturer by means of manufacturer's printed Notification of Completion form of job completion in order to schedule a final inspection date.

C. Final Inspection:

1. Post-Installation Meeting: Hold a meeting at the completion of the project, attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the manufacturer's representative. Complete, sign, and mail the punch list form to the manufacturer's headquarters.

D. Issuance Of The Guarantee: Complete all post installation procedures and meet the manufacturer's final endorsement for issuance of the specified guarantee.

End of Section

DIVISION 7 - THERMAL & MOISTURE PROTECTION

SECTION 07600 - FLASHING AND SHEET METAL

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this section of the work.

1.02 Related Work Specified Elsewhere:
- A. Modified Bitumen Membrane Roofing System - Section 07550
- B. Sealants - Section 07900

1.03 Quality Assurance:
- A. Standards:
  - 1. American Society of Testing and Materials
    - a. ASTM A-526, Steel Sheet, Zinc-Coated (Galvanized), Commercial Quality.
    - b. ASTM B-32, Solder Metal
  - 2. Federal Specifications:
    - a. SS-C-153B, Cement, Bituminous, Plastics
  - 3. Sheet Metal and Air Conditioning Contractors National Association:
    - a. Architectural Sheet Metal Manual

1.04 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.**

Part 2 - Products

2.01 Materials:
- A. Prefinished Sheet Metal overflow scuppers and Prefinished Metal Coping:
  - 1. Galvanized iron, prefinished one side.
  - 2. Gauge: 24 gauge, of design and width as detailed.
  - 3. Acceptable manufacturer: Color Klad - Vincent Brass and Aluminum Co.
  - 4. Finish: Kynar 500 - Refer Color Schedule
- B. Sheet Metal:
  - 1. Galvanized Sheet Steel: ASTM A-526, Commercial Quality.
  - 2. Gauge: 22 Gauge minimum or as required by Drawings or Specifications.
- C. Fasteners: Nails, screws, and other fasteners used in conjunction with this work shall be galvanized or cadmium plated.
- D. Solder: ASTM B-32, alloy grade 58, 50% tin, 50% lead.
- E. Flux: Muriatic acid with zinc.
- F. Sealants: Rubber based compound - refer to Section 07900.
- G. Bituminous Plastic Cement: FS SS-C-153B.

H. Accessories: Provide accessories as recommended by manufacturer or as indicated on Drawings.

Part 3 - Execution

3.01 Fabrication:

A. Shape and install sheet metal as indicated on Drawings. Comply with recommendations of SMACNA "Architectural Sheet Metal Manual."

B. Form exposed faces flat and free of buckles, excessive wave and tool marks. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

C. Hem all exposed edges.

D. Make waterproof corner joints by soldering solidly. Joints shall be full-lapped.

E. Soldering: Shall be done slowly with well heated coppers to thoroughly heat the sheet and completely sweat the solder through the full width of the seam. Ample solder shall be used and the seam shall show a least one full inch of evenly flowed solder. Soldering coppers: Shall be heavy and blunt design, properly tinned before using. Neutralize all excess flux.

F. Provide for thermal expansion of running trim, flashing and other items exposed for more than 15'-0" continuous length. Locate expansion seams at 10'-0" intervals and 2'-0" each side of corners and intersections.

G. Angle bottom edges of exposed vertical surfaces to form drips.

3.02 Installation and Application:

A. General:

1. Furnish those items to be installed by other trades to proper grade for installation.
2. Cooperate with and coordinate installation of sheet metal with roofing work as specified under Modified Bitumen Membrane Roofing System - Section 07550.
3. Install work watertight, without waves, warps, buckles, fastening stresses or distortion, allowing for expansion and contraction.
4. Embed all flashing in plastic cement. Coat dissimilar metals from contact with bituminous coating.

B. Metal Coping:

1. Material: 24 gauge, prefinished sheet metal.
2. Fabricate and install in accordance with drawings, and recognized sheet metal practices.
3. Secure coping bedded in plastic cement to blocking.
4. At joints, bed coping in plastic cement and secure on side to backing strip by soldering solid. Do not use screws

or nails in exposed face to coping.

5. Lower edge of coping to be securely hooked to hook strip. Secure to wood blocking with No. 8 x 1" galvanized sheet metal screws at 8 o.c.

End of Section

DIVISION 7 - THERMAL & MOISTURE PROTECTION

SECTION 07700 - ROOF ACCESSORIES

Part 1 General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this entire section of the work.

1.02 Submittals:
- A. Shop Drawings: Indicate details and dimensions of fabrication and installation including layouts and assemblies. Begin fabrication only after receiving approved shop Drawings.
- B. Manufacturer's Literature: Descriptive literature and installation instructions.

1.03 Product Delivery, Storage and Handling:
- A. Handle and store all items with care to prevent damage and injury to finish surfaces.

Part 2 - Products

2.01 Type NB Roof Hatch:
- A. Size and Construction: 2’-6” x 4’-6” (5'-1" x 3'-1" overall dimensions), single leaf type. Cover shall be 14 gauge paint bond galvanized steel with a 3" beaded flange, neatly welded. Insulation shall be glass fiber 1" in thickness, fully covered and protected by a 22 gauge paint bond steel (or 18 gauge aluminum) liner.
- B. Curb shall be 12" in height and of 14 gauge paint bond galvanized steel. It shall be formed with a 3-1/2" flange with holes provided for securing to the roof deck. Curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, full welded at the corners for weathertightness. Insulation on the exterior of the curb shall be rigid fiber board 1" in thickness.
- C. Scuttle shall be completely assembled with heavy piano hinges, compression spring operators enclosed in telescopic tubes, positive snap latch with turn handles and padlock hasps inside and outside, and thermoplastic rubber gasket. Cover shall be equipped with an automatic hold-open arm complete with vinyl grip handle to permit easy release. All hardware shall be zinc plated and chromate sealed.
- D. Manufacturer: The Bilco Company or approved equal.

Part 3 - Execution

3.01 Installation:
- A. Installation shall be in accordance with manufacturer's instructions.
- B. Coordinate installation of handrail to underside of hatch lid, to be used in conjunction with the ladder as detailed on the drawings.
- C. Coordinate with installation of roofing system and related flashings.

End of Section

DIVISION 7 - THERMAL & MOISTURE PROTECTION

SECTION 07840 - FIRESTOPPING

Part 1 - General

1.01 Related Documents:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Section, apply to work specified in this section.

1.02 Definitions:

A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in, or construction joints between, fire rated wall and floor assemblies.

1.03 General Description of the Work:

A. Only tested firestop systems shall be used in specific locations as follows:

1. Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
2. Safing slot gaps between edge of floor slabs and curtain walls.
3. Openings between structurally separate sections of wall or floors.
4. Gaps between the top of walls and ceilings or roof assemblies.
5. Expansion joints in walls and floors.
6. Openings and penetrations in fire-rated partitions or walls containing fire doors.
7. Openings around structural members which penetrate floors or walls.

1.04 Related Work Specified Elsewhere:

A. Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:

1. Section 03300 - Cast-In-Place Concrete
2. Section 04810 - Masonry
3. Section 07900 - Sealants
4. Section 09250 - Gypsum Wallboard
5. Section 13195 - Fire Suppression Piping
6. Section 15052 - Common Work Results for Plumbing
7. Section 15053 – Common Work Results for HVAC
8. Section 15083 - HVAC Insulation
9. Section 16050 - Basic Electrical Materials and Methods

1.05 References:

SECTION 07840 - FIRESTOPPING

A. Test Requirements: ASTM E 814, "Standard Method of Fire Tests of Through Penetration Fire Stops".
B. Test Requirements: UL 1479, "Fire Tests of Through-Penetration Firestops".
C. Test Requirements: UL 2079, "Tests for Fire Resistance of Building Joint Systems".
D. Underwriters Laboratories (UL) of Northbrook, IL publishes tested systems in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
   1. UL Fire Resistance Directory:
      a. Firestop Devices (XHJI)
      b. Fire Resistance Ratings (BXRH)
      c. Through-Penetration Firestop Systems (XHEZ)
      d. Fill, Voids, or Cavity Material (XHHW)
      e. Forming Materials (XHKU)
      f. Joint Systems (XHBN)
      g. Perimeter Fire Containment Systems (XHDG)
   2. Alternate Systems: "Omega Point Laboratories Directory" (updated annually).
E. Test Requirements: ASTM E 1966, "Standard Test Method for Fire Resistive Joint Systems".
F. Inspection Requirements: ASTM E 2174, "Standard Practice for On-site Inspection of Installed Fire Stops".
H. ASTM E 84, "Standard Test Method for Surface Burning Characteristics of Building Materials".
I. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.
J. All major building codes: ICBO, SBCCI, BOCA, IBC
K. NFPA 101 - Life Safety Code
L. NFPA 70 - National Electric Code

THROUGH-PENETRATION UL CLASSIFICATION SYSTEM

Fire Stopping Systems		UL Classification System	
	Construction Penetrated	Type Of Construction	System Identification
1 No Penetrating Items:	F, W, C	A, B, J, K, L	0001-0999
2 Metallic Pipes, Conduit or Tubing:	F, W, C	A, B, J, K, L	1001-1999
3 Nonmetallic Pipe, Conduit or Tubing:	F, W, C	A, B, J, K, L	2001-2999
4 Electric Cables:	F, W, C	A, B, J, K, L	3001-3999
5 Cable, Trays with Electric Cables:	F, W, C	A, B, J, K, L	4001-4999
6 Insulated Pipes:	F, W, C	A, B, J, K, L	5001-5999
7 Electrical Bussduct Penetrations:	F, W, C	A, B, J, K, L	6001-6999

8	Mechanical Ductwork Penetrations:	F, W, C	A, B, J, K, L	7001-7999
9	Multiple Penetrations Through Common Openings:	F, W, C	A, B, J, K, L	8000-8999

Construction Penetration

F	Floor penetration
W	Wall penetration
C	Either floor or wall penetration

Type of Construction

A-	Concrete floors equal to of less than 5-inches thick
B-	Concrete floors greater than 5-inches thick
J-	Concrete or masonry walls equal to or less than 8-inches thick
K-	Concrete of masonry walls greater than 8-inches thick
L-	Framed walls

JOINT UL CLASSIFICATION SYSTEM

Fire-Resistant Joint Systems		UL Classification System		
		Joint System	Movement Capability	Joint Width
1	Floor-to-Floor	FF	D	0000-0999
2	Wall-to-Wall	WW	D	0000-0999
3	Floor-to-Wall:	FW	D	0000-0999
4	Head of Wall:	HW	D	0000-0999

Movement Capability

D-	Has movement capability

Joint Width

0000-0999 Less than or equal to 2-inches

1.06 Quality Assurance

A. Installer Responsibilities: A firm experienced installing through-penetration firestop systems similar in material, design and extent to that indicated for this Project, whose work has resulted in construction with a record of

successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements.

B. Firestop System installation must meet requirements of ASTM E 814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.

C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

D. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

E. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

1.07 Submittals:

A. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of qualified tested firestop systems to be used and manufacturer's installation instructions.

B. Submit Manufacturer's engineering judgment identification number and drawing details when no qualified tested system is available for an application. Engineering judgment must include both project name and contractor's name who will install firestop system as described in document.

C. Submit material safety data sheets provided with product delivered to job-site.

1.08 Installer Qualifications:

A. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements.

B. The work is to be installed by a contractor with at least one of the following qualifications:

1. FM 4991 Approved Contractor
2. UL Approved Contractor
3. Hilti Accredited Fire Stop Specialty Contractor

C. Installer shall have not less than 3 years of experience with fire stop installation.

1.09 Delivery, Storage and Handling:

A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.

B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements,

including temperature restrictions.

D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

E. Do not use damaged or expired materials.

1.10 Project Conditions:

A. Do not use materials that contain flammable solvents.

B. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.

E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

1.11 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers, providing they meet or exceed that specified.**

Part 2 – Products

2.01 Firestopping, General:

A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

C. Firestopping Materials are either “cast-in-place” (integral with concrete placement) or “post installed.” Provide cast-in-place firestop devices prior to concrete placement.

2.02 Acceptable Manufacturers:

A. Subject to compliance with through penetration firestop systems (XHEZ), joint systems (XHBN), and perimeter firestop systems (XHDG) listed in Volume 2 of the UL Fire Resistance Directory; provide products of the following manufacturers as identified below:

1. Hilti, Inc., Tulsa, Oklahoma
   800-879-8000 / www.us.hilti.com

2.03 Materials:

A. Use only firestop products that have been UL 1479, ASTM E 814 or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

B. Pre-installed firestop devices for use with noncombustible and combustible pipes (closed and open systems), conduit, and/or cable bundles penetrating concrete floors and/or gypsum walls, the following products are acceptable:
   1. Hilti CP 680-P Cast-In Place Firestop Device
      a. Add Aerator adaptor when used in conjunction with aerator ("sovent") system.
   2. Hilti CP 681 Tub Box Kit for use with tub installations.
   3. Hilti CP 680-M Cast-In Place Firestop Device for use with noncombustible penetrants.
   4. Hilti CP 653 Speed Sleeve for use with cable penetrations.

C. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
   1. Hilti FS-ONE Intumescent Firestop Sealant
   2. Hilti CP 604 Self-leveling Firestop Sealant
   3. Hilti CP 620 Fire Foam
   4. Hilti CP 606 Flexible Firestop Sealant
   5. Hilti CP 601s Elastomeric Firestop Sealant

D. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
   1. Hilti CP 601s Elastomeric Firestop Sealant
   2. Hilti CP 606 Flexible Firestop Sealant
   3. Hilti FS-ONE Intumescent Firestop Sealant

E. Sealants, caulking or spray materials for use with fire-rated construction joints and other gaps, the following products are acceptable:
   1. Hilti CP 672 Speed Spray
   2. Hilti CP 601s Elastomeric Firestop Sealant
   3. Hilti CP 606 Flexible Firestop Sealant
   4. Hilti CP 604 Self-leveling Firestop Sealant

F. Pre-formed mineral wool designed to fit flutes of metal profile deck and gap between top of wall and metal profile deck; as a backer for spray material.
   1. Hilti CP 777 Speed Plugs
   2. Hilti CP 767 Speed Strips

G. Intumescent sealants, caulking materials for use with

combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:

1. Hilti FS-ONE Intumescent Firestop Sealant

H. Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles, the following products are acceptable:

1. Hilti FS-ONE Intumescent Firestop Sealant
2. Hilti CP 620 Fire Foam
3. Hilti CP 601s Elastomeric Firestop Sealant
4. Hilti CP 606 Flexible Firestop Sealant

I. Non-curing, re-penetrable intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:

1. Hilti CP 618 Firestop Putty Stick
2. Hilti CP 658T Firestop Plug

J. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:

1. Hilti CP 617 Firestop Putty Pad
2. Hilti Firestop Box Insert

K. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:

1. Hilti CP 643N Firestop Collar
2. Hilti CP 644 Firestop Collar
3. Hilti CP 648E/CP648S Wrap Strips

L. Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:

1. Hilti CP 637 Firestop Mortar
3. Hilti FS 657 FIRE BLOCK
4. Hilti CP 620 Fire Foam
5. Hilti CP 675T Firestop Board

M. Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:

1. Hilti FS 657 FIRE BLOCK
2. Hilti CP 675T Firestop Board

N. Sealants or caulking materials used for openings between structurally separate sections of wall and floors, the following products are acceptable:

1. Hilti CP 672 Speed Spray
2. Hilti CP 601s Elastomeric Firestop Sealant
3. Hilti CP 606 Flexible Firestop Sealant

4. Hilti CP 604 Self-Leveling Firestop Sealant

O. For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:
   1. Hilti FS 657 FIRE BLOCK
   2. Hilti CP 658T Firestop Plug

P. Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E814 which is equal to the time rating of construction being penetrated.

Q. Provide a firestop system with an Assembly Rating as determined by UL 2079 which is equal to the time rating of construction joint assembly.

Part 3 - Execution

3.01 Preparation:

A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
   1. Verify penetrations are properly sized and in suitable condition for application of materials.
   2. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
   3. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
   4. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
   5. Do not proceed until unsatisfactory conditions have been corrected.

3.02 Coordination:

A. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.

B. Responsible trades to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

3.03 Installation:

A. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory or Omega Point Laboratories Directory.

B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.
   1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.

2. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
3. Protect materials from damage on surfaces subjected to traffic.

3.04 Field Quality Control:

A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
B. Keep areas of work accessible until inspection by applicable code authorities.
C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, “Standard Practice for On-Site Inspection of Installed Fire Stops” or other recognized standard.
D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.05 Identification:

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
   1. The words: "Warning -Through Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's Name, address, and phone number.
   3. Through-Penetration firestop system designation of applicable testing and inspecting agency.
   4. Date of Installation.
   5. Through-Penetration firestop system manufacturer's name.
   6. Installer's Name.

3.06 Adjusting and Cleaning:

A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

End of Section

DIVISION 7 - THERMAL & MOISTURE PROTECTION

SECTION 07900 - SEALANTS

Part 1 - General

1.01 Work Included:
A. All materials, labor services, and incidentals necessary for the completion of this section of the work.

1.02 Quality Assurance:
A. Standards:
1. TT-S-00230C, Sealing Compound, One Component.
2. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.03 Submittals:
A. Submit manufacturer's specifications and color chart for each type of sealant.
B. Samples: For each kind and color of joint sealant required.
C. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.
D. Product test reports.
E. Preconstruction compatibility and adhesion test reports.
F. Preconstruction field-adhesion test reports.
G. Field-adhesion test reports.

1.04 Warranty:
A. All work done under this section of the work shall be guaranteed for a period of two years from date of final acceptance of the building. Guarantee shall include materials and workmanship required to repair any leaks or the repairs thereof.
B. Special Warranty: Manufacturer’s standard form in which joint sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section for a period of 10 years from date of final acceptance.

1.05 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.**

Part 2 - Products

2.01 Materials:
A. Building Sealant: One part high performance polyurethane waterproofing sealant, FS-TT-S-00230C.
1. Acceptable Manufacturer: Sonneborn NP1 Building Sealant.
2. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall

comply with the following limits for VOC content when calculated according to 40 CPR 59, Subpart D (EPA Method 24):

a Architectural Sealants: 250 gIL.

b. Sealant Primers for Nonporous Substrates: 250 gIL.

c. Sealant Primers for Porous Substrates: 775 gIL.

3. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

a. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

4. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

5. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CPR 177.2600.

B. Silicone Joint Sealants:

1. Mildew-Resistant Neutral-Curing Silicone Joint Sealant: ASTM C 920.

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. BASF Building Systems.
2. Dow Corning Corporation.
3. GE Advanced Materials - Silicones.
4. Pecora Corporation.
5. Sika Corporation; Construction Products Division.
6. Tremco Incorporated.

C. Urethane Joint Sealants: Urethane Joint Sealant: ASTM C 920.

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. BASF Building Systems.
b. Bostik, Inc.
c. Lymtal, International, Inc.
d. Pecora Corporation.
e. Sika Corporation; Construction Products Division.
f. Tremco Incorporated.

D. Latex Joint Sealants: Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, GradeNF.
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. BASF Building Systems.
b. Bostik, Inc.
c. Pecora Corporation.
d. Tremco Incorporated.

E. Preformed Joint Sealants: Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
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. Dayton Superior Specialty Chemicals.
b. EM SEAL Joint Systems, Ltd.
c. Sandell Manufacturing Co.
d. Schul International, Inc.
e. Willseal USA, LLC.

F. Acoustical Joint Sealants: Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
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. USG Corporation.

G. Joint Sealant Backing: cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type 0 (open-cell material) 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.
   1. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

H. Miscellaneous Materials: as recommended by sealant manufacturer.
   1. 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.
   2. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
   3. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.
   4. Joint Cleaner
   5. Joint Primer/Sealer
   6. Bond Breaker Tape
   7. Joint Backer-Rod: Closed-cell compressible rod stock, size and shape as required by application.

I. Caulking compound: Watertight, gun consistency, conforming to FS-TT-C-598, Type 1.

J. Accessories: As recommended by sealant manufacturer.

K. Color: to be selected from manufacturer’s standard colors.

Part 3 - Execution

3.01 Preparation:

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
   1. Remove laitance and form-release agents from concrete.
   2. 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.

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.

3.02 Installation: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated. Install sealant backings of kind 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.

A. Do not leave gaps between ends of sealant backings.

B. Do not stretch, twist, puncture, or tear sealant backings.

C. 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 per Figure 8A in ASTM C 1193, unless otherwise indicated.

G. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.

H. 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.

3.03 Joint Sealant Schedule:

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal non traffic surfaces.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces.

F. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal non traffic surfaces.

3.04 Additional Information:

A. Application: All sight exposed caulking, and all exterior applications.

B. Comply with sealant manufacturer's printed instructions.

C. Any surfaces requiring priming, shall be prepared according to manufacturer's recommendations.

D. Install sealants to depths as shown or as recommended by sealant manufacturer. Smooth uneven surfaces.

F. Do not disturb compound by touching, washing, or otherwise until it has cured tack free.

G. Excess compound shall be removed from surfaces after curing.

H. Follow manufacturer's recommendations for painting over sealant.

End of Section

SECTION 08100 - METAL DOORS AND FRAMES

Part 1 - General

1.01 Work Included:
- A. All material labor, services and incidentals necessary for the completion of this section of the work.

1.02 Related Work Specified Elsewhere:
- A. Hardware and Specialties - Section 08700

1.03 Quality Assurance:
- A. Standards:
  1. American Society for Testing and Materials
     - a. ASTM A-366, Steel Sheets, Carbon, Cold-Rolled, Commercial Quality.
     - b. ASTM A-569, Steel, Carbon, Hot-rolled Sheet and strip, commercial quality.
  2. Underwriters' Laboratories, Inc.
  3. Steel Door Institute (SDI): Recommended specifications for Steel Doors and Frames.
- B. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- C. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.
- D. Fire-Rated Door Frame Assemblies: Assemblies complying with IBC 2009 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire protection ratings indicated.
  1. Test Pressure: Test according to NFPA 252. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches (1000 mm) or less above the sill.
  2. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F (250 deg C) maximum in 30 minutes of fire exposure.
  3. Smoke-Control Door Assemblies: Comply with NFPA 105.

1.04 Submittals:
- A. Shop Drawings: Product Data: Include construction details, material descriptions, core descriptions, label compliance, and finishes for each type of steel door and frame specified.
  1. Submit shop Drawings showing details for each frame and door type, elevations and details of construction. Provide a schedule of doors and frames referenced to detail and openings as shown on the Drawings.
     - a. Elevations of each door design.
     - b. Details of doors, including vertical and horizontal edge details.
     - c. Frame details for each frame type, including dimensioned profiles.
     - d. Details and locations of reinforcement and

preparations for hardware.
e. Details of each different wall opening condition.
f. Details of anchorages, accessories, joints, and connections.
g. Details of glazing frames and stops showing glazing.
h. Details of conduit and preparations for electrified door hardware and controls.

2. It is the manufacturer's responsibility to obtain templates of finish hardware. The shop Drawings must indicate all hardware applications to the doors and frames.
3. Begin fabrication only after receiving approved shop Drawings.
4. Qualification Data: For Installer.

1.05 Product Delivery, Storage and Handling:

A. All materials shall be protected for shipping so that they may arrive at the job site without undue damage or damage from storage at the job.
B. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
C. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
D. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Avoid using non-vented plastic or canvas shelters that could create a humidity chamber.
1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 114-inch space between each stacked door to permit air circulation.

1.06 Project Conditions:

A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating standard steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.07 Coordination:

A. Coordinate installation of anchorages for standard steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves,

concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in masonry. Deliver such items to Project site in time for installation.

1.08 Warranty: Provide manufacturer's standard warranty.

Part 2 - Products

2.01 Acceptable Manufacturers:

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

1. CURRIES Company; an ASSA ABLOY Group Company.
2. Steelkraft; and Ingersoll-Rand Company.
3. Or Approved Equal.

2.02 Materials:

A. Cold-Rolled Steel Sheet: ASTM A 100S/A 100SM, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 10111A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 zinc-iron-alloy (galvannealed) coating designation.

D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 5911A 59 1M, Commercial Steel (CS), Class B coating; mill phosphatized.

E. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.

G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.

H. Glazing: Comply with requirements in Division S Section "Glazing."

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for I5-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

J. Grout: In masonry construction use grout for masonry as specified in Division 4. In stud walls use cementitious sprayed fire-resistive material manufactured by the

following:

1. Monokote Type MK-6; W.R. Grace Construction Products.
2. Cafco 300; Isolatek International Corp.

2.03 Requirements: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.

A. Doors – Flush Panel: (SDI Door Type III, Style 2, Seamless):

1. Door, as indicated on the Drawings shall be constructed of 16 gauge cold-rolled, stretcher leveled sheet steel. Doors shall be insulated with foamed urethane, full length and width of doors. Construct doors with smooth, flush surfaces without visible joints or seams on exposed face or vertical edges. Doors shall be 1-3/4” thick unless noted otherwise.
2. Close top and bottom edges with a recessed channel end closure or a flush end closure treatment.
3. Vertical Edges for Single-Acting Doors: Square edge unless beveled edge is indicated.
   a. Beveled Edge: 1/8 inch in 2 inches.
4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.
5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
6. Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

B. Frames:

1. Hollow metal frames shall be of 16 gauge cold-rolled, pickled steel, except that all frames for single doors over 3'-0" wide, frames for pairs of doors over 4'-0" wide and frames for doors over 9'-0" high shall be of 14 gauge steel. Frames shall be neatly mitered and continuously welded and ground smooth for invisible joints.
2. Furnish anchors as shown on Drawings or as recommended by manufacturer, to secure frames to adjacent construction, formed of not less than 18 gauge galvanized steel. Install anchors at a maximum of 24' centers of jamb height.
3. Frames against masonry or concrete are to be slush filled.
4. Knock-down frames are not permitted.
5. Frames against masonry or concrete are to be slush filled.
6. Jamb Anchors:
   a. Masonry Type: Adjustable strap-and-stirrup or T - shaped anchors to suit frame size, not less than

0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.

b. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

c. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

d. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch-wide steel.

e. Plaster Guards: Formed from same material as frames, not less than 0.016-inch thick.

7. Sidelight Frames: Provide closed tubular members with no visible face seams or joints; fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.

C. Hardware Reinforcement:

1. Reinforcements for locks shall be 3/16" for fronts, with 14 gauge for roses and escutcheons. Hinge reinforcements shall be at least 10 gauge x 1 **2**" x 9". Provide steel strike and hinge reinforcement cover for frames.

D. Jamb Anchors: Provide number and spacing of anchors as follows:

1. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

a. Two anchors per jamb up to 60 inches in height.

b. Three anchors per jamb from 60 to 90 inches in height.

c. Four anchors per jamb from 90 to 120 inches in height.

d. Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 120 inches in height.

2. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
   a. Three anchors per jamb up to 60 inches in height.
   b. Four anchors per jamb from 60 to 90 inches in height.
   c. Five anchors per jamb from 90 to 96 inches in height.
   d. Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.
   e. Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.

E. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
   1. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   2. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

F. Stops and Moldings:
   1. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.
   2. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch high, unless otherwise indicated.
   3. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

G. Labeled Doors and Frames:
   1. Where doors and frames are called for on Drawings as labeled, their construction shall conform to all requirements and bear the appropriate U.L. label.

H. Steel Finishes
   1. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
      a. Finish standard steel door and frames after assembly.
   2. Metallic-Coated Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A

780.

a. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

3. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP *6/NACE* No.3, "Commercial Blast Cleaning."

4. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.

a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

Part 3 - Execution

3.01 Fabrication:

A. All doors, and frames shall be cleaned of rust, grease and other impurities, and all welds ground and filled smooth, Metallic filler to conceal defects is not acceptable.

B. Doors and frames shall be mortised, reinforced, drilled, and tapped for all mortise hardware in accordance with Hardware schedule and templates furnished by the hardware supplier, except that drilling and tapping for surface door closers, door closer brackets, surface panic devices and/or other surface applied hardware shall be done in the field. Frames shall be accurate and done in a neat, workmanlike manner.

3.02 Installation:

A. Standard Steel Frames: Install standard steel frames for doors sidelights borrowed lights and other openings, of size and profile indicated. Comply with SDI 105.

1. Bituminous coating and grout: Any material lost, removed or damaged during transportation or installation shall be replaced.

2. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set.

After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-protection-rated openings, install frames according to NFP A 80.
b. Install frames with removable glazing stops located on secure side of opening.
c. Install door silencers in frames before grouting.
d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
e. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

3. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with post-installed expansion anchors.
   a. Floor anchors may be set with powder-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.
4. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 4 Section "Unit Masonry Assemblies."
6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
7. Installation Tolerances: Adjust standard steel door frames for squareness, alignment, twist, and plumb 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.

B. Standard Steel Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
   1. Non-Fire-Rated Standard Steel Doors:
      a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
      b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
      c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
      d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum ¾ inch.
   2. Fire-Rated Doors: Install doors with clearances according to NFP A 80.
   3. Smoke-Control Doors: Install doors according to NFPA 105.

C. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with standard steel door and frame manufacturer's written instructions.

3.03 Adjusting and Cleaning:

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.

B. Clean grout and other bonding material off standard steel doors and frames immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

D. Galvannealed Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions. Do not use abrasive, caustic or acid cleaning agents.

E. Protect doors and frames from damage until final acceptance by Contracting Officer. Replace/repair any damaged items as directed above.

End of Section

SECTION 08200 - WOOD DOORS

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this section of the work.

1.02 Related Work Specified Elsewhere:
- A. Finish Hardware - Section 08700

1.03 Quality Assurance:
- A. Standards:
  1. Architectural Woodwork Institute:
     a. Architectural Woodwork Quality Standards
  2. Underwriter's Laboratories, Inc.
- B. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-Accredited certification body.
- C. Source Limitations: Obtain flush wood doors from single manufacturer.
- D. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
- E. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at according to NFPA 252 and UL 10B.
  1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
  2. 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.
  3. Fire-Rated Doors must be provided with fire labels.

1.04 Submittals:
- A. Shop Drawings:
  1. It is the manufacturer's responsibility to obtain templates of finish hardware. The shop Drawings must indicate all hardware applications to the doors.
  2. Begin fabrication only after receiving approved ship Drawings.
  3. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
  4. Samples for Initial Selection: Color charts consisting

of actual materials in small sections.

5. Samples for Verification:
   a. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
6. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.05 Products Delivery, Storage and Handling:

A. When doors are delivered to job site, doors shall receive first coat of finish. Store in a protected area.
B. Comply with requirements of referenced standard and manufacturer's written instructions.
C. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
D. Mark each door on bottom rail with opening number used on Shop Drawings.

1.06 Warranty:

A. General Warranty: Door manufacturer's warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
B. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section or that show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span, or do not comply with tolerance limitations in referenced quality standard.
   1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
   2. Warranty shall be in effect during the following period of time after date of Final Completion.
      a. Solid Core Interior Doors: Life of installation.

Part 2 - Products

2.01 Doors (non-labeled):

A. Doors shall be 1 3/4" thick interior grade, veneered, with a particleboard core. Construction shall meet AWI 1300 PC, "Custom" standard. Doors shall have I.S. "Premium" grade

faces - Plain Sliced Red Oak. Provide hardwood top, bottom, and side edges.

2.02 Doors (labeled):

A. Doors shall be 1 3/4" thick interior grade, veneered, with a mineral core (refer to Drawings for ratings). Construction shall meet AWI 1300 FD, "Custom" standard. Doors shall have I.S. "Premium grade faces - Plain Sliced Red Oak. Provide hardwood top, bottom, and side edges.

B. Where doors are called for on drawings as labeled their construction shall conform to all U.L. requirements and bear the appropriate U.L. label.

2.03 Acceptable 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. Algoma Hardwoods, Inc.
2. Ampco, Inc.
3. Buell Door Company Inc.
4. Chappell Door Co.
5. Eagle Plywood & Door Manufacturing, Inc.
6. Eggers Industries.
7. Graham; an Assa Abloy Group company.
8. Haley Brothers, Inc.
9. Ideal Architectural Doors & Plywood.
10. Ipik Door Company.
11. Lambton Doors.
12. Marlite.
13. Marshfield Door Systems, Inc.
14. Mohawk Flush Doors, Inc.; a Masonite company.
15. Oshkosh Architectural Door Company.
16. Poncraft Door Company.
17. Vancouver Door Company.
18. VT Industries Inc.

2.04 Door Construction – General:

A. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade 1L-1, made with binder containing no ureaformaldehyde resin.
2. Blocking - Provide wood blocking in particleboard-core doors as follows:
   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.
3. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

B. Fire-Protection-Rated Doors: Provide core specified or

mineral core as needed to provide fire protection rating indicated.

1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
3. Pairs: Provide formed-steel edges and astragals with intumescent seals.

C. Factory Finishing: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
2. Finish doors at factory.
3. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.
4 Transparent Finish:
    1. Grade: Premium.
    2. Finish: WDMA TR-6 catalyzed polyurethane.
    3. Staining: Water-based stain with transparent ultraviolet cured catalyzed polyurethane. Color as selected by Architect from manufacturer's full range.
    4. Effect: Open-grain finish.
    5. Sheen: Semigloss.

Part 3 - Execution

3.01 Examination:

A. Examine doors and installed door frames before hanging doors.
    1. Verify that 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.

3.02 Installation:

A. Provide clean properly sized and accurately placed mortises

and drilled holes for all mortise and surface mounted finish hardware, in accordance with Hardware Schedule and templates furnished by the hardware supplier.

B. Comply with the tolerance requirements of AWI for prefitting. Install in accordance with the requirements of the NWMA Door Guarantee.

C. Repair or replace doors damaged during installation. Repair doors which do not swing or operate properly.

D. Hardware: For installation, see Division 08 Section "Door Hardware."

E. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
   1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

F. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
   1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide l inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
      a. Comply with NFP A 80 for fire-rated doors.
   2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
   3. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

G. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

H. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.03 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

SECTION 08310 - TORNADO DOORS

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this section of the work.

1.02 System Description:
- A. Design Requirements - Tornado Doors:
  1. ICC 500-2014 Tornado Doors.

1.03 Submittals:
- A. Shop Drawings: Indicate details and dimensions of fabrications and installation, including any operators and controllers.
- B. Manufacturer’s Literature: Descriptive literature and installation instructions.

1.04 Quality Assurance:
- A. Qualifications:
  1. Manufacturer Qualifications: Minimum five years of experience in producing doors of the type specified.
  2. Installer Qualifications: Manufacturer's approval.
  3. Doors shall have fire resistance rating as per the drawings.

1.05 Delivery Storage and Handling:
- A. Follow manufacturer's instructions.

1.06 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.**

Part 2 - Products

2.01 General:
- A. Refer to Drawings for location, size, and details.

2.02 Tornado Door:
- A. Locations: provide where indicated on the drawings (Doors #43 and 52).
- B. Acceptable Manufacturer:
  1. Manufacturer and model number:
     a. Steelcraft - Ingersoll Rand Security Technologies / Paladin PW-Series Flush Doors and FP14 Frame.
     b. Republic Doors and Frames, Inc. / DE Series - FEMA 361 Flush Doors.
     c. Provide Underwriters Laboratories, Inc. label for the fire rating classification where applicable.

C. Materials:
1. Door Construction:
a. Face Skins: 14 gage A-60 Galvannealed Steel.
b. Hinge and Rail Reinforcement: hinge edge is non-beveled and reinforced with a continuous 10 gage steel channel projection welded at 5" on center maximum.
c. Top and Bottom Channels: inverted steel channel - 14 gage at top and 16 gage at bottom, welded at 2.5" on center maximum.
d. Core: steel stiffened (both doors) with filler as required to obtain applicable strength rating at Door #5.
e. Lock Rail: beveled and reinforced with continuous 14 gage steel channel welded at 5" on center maximum.
f. Closer Reinforcement: 14 gage.
g. Stiffeners: 18 gage, 4" wide spaces at 6" on center maximum and welded at 5" on center maximum vertically.
h. Top and Bottom Channels: 14 gage inverted steel channels with additional 12 gage flush channel.
2. Provide factory applied baked-on rust inhibiting primer in accordance with ANSI A250.10-1998.
3. Refer to Section 08700 Finish Hardware for additional information concerning hardware for these doors and frames.

2.03 Hardware:

A. Provide hardware as per the following:

Hardware Group No. 2 - Door #5: Provide each PR exterior tornado door(s) with the following:

Quantity	Description	Model Number	Finish	Mfr
6 EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
2 EA	FIRE EXIT HARDWARE	WS9827/9927L 996L-R/V LENGTH AS REQUIRED	626	VON
2 EA	RIM CYLINDER	20-057 ICX	626	SCH
1 EA	MORTISE CYLINDER	20-061 ICX	626	SCH
3 EA	CLASSIC CORE	23-030	626	SCH
1 SET	ASTRAGAL	9115A HEIGHT AS REQ	AL	NGP
2 EA	SURFACE CLOSER	4041 OR P4041 MTG BRKTS, SPCRS & PLATES AS REQ	689	LCN
2 EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
2 EA	FLOOR STOP	WS407CCV OR FS436 AS REQ'D	628	IVE

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1 SET	SEALS	5050B H & J	BLK	NGP
1 EA	DOOR SWEEP	101VA LGTH AS REQ?D.	AL	NGP
1 EA	THRESHOLD	892V LGTH AS REQ?D.	AL	NGP

SUPPLIER TO VERIFY HARDWARE SPECIFIED AND REVISE AS NECESSARY TO MEET THE REQUIREMENTS OF ICC 500-2014 / latest required regulations and/or codes.

Part 3 - Execution

3.01 Installation:

A. Verify that openings are prepared with headers level, jambs plumb, floor level, without projections, etc. and are correctly dimensioned to receive doors.

B. Install in compliance with manufacturer's instruction. Hang straight, plumb and level, and adjust for smooth, quiet operation.

1. At tornado doors, comply with FEMA Regulations and follow manufacturer's instructions. **Provide complete assembly to meet FEMA 361 and other applicable codes.**

C. Prior to final acceptance of the project, inspect all work done under this section, and make all necessary adjustments, repairs or replacements of defective work.

End of Section

SECTION 08330 – TORNADO RESISTANT COILING DOORS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Provide all materials, labor, equipment and services necessary to furnish, deliver and install all work under this section as shown on the contract documents, specified herein, and as specified by the job conditions.

1.02 DESCRIPTION

A. Related work specified elsewhere:
   1. Metal Fabrication. Section 05500
   2. Rough Carpentry. Section 06100
   3. Painting: Section 09900
   4. Electrical: Division 26

1.03 SUBMITTALS

A. Procedures: Furnish submittals in accordance with the general requirements specified.

B. Shop Drawing: Furnish shop drawings for architect's approval. Include elevations, sections, and details indicating dimensions, materials, finishes, conditions for anchorage and support of each coiling door.

C. Listings and Certifications:
   1. Listed, labeled and certified by an IAS accredited nationally recognized testing laboratory for product compliance with FEMA 361 Safe Rooms for Tornadoes.
   2. Listed, labeled and certified by an IAS accredited nationally recognized testing laboratory to ICC 500-2020 Standard for Design and Construction of Storm Shelters.
   3. Listed, labeled and certified by an IAS accredited nationally recognized testing laboratory for a wind pressure rating of 302psf (1.2 times the design wind pressure of 252psf) in accordance with ASTM E330.
   4. Listed, labeled and certified by an IAS accredited nationally recognized testing laboratory for Large Missile Impact rating in accordance with the requirements of ASTM E1886 for FEMA 361 Safe Rooms for Tornadoes.

D. Product Literature: Submit manufacturer's technical literature describing the product to be used under this section.

E. Maintenance and Operating Manuals: Furnish complete manuals describing the materials, devices and procedures to be followed in operating and maintaining all tornado and hurricane resistant coiling doors under this section. Include manufacturer's brochures and parts lists describing the actual materials used in the product.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable FEMA requirements as well as laws, codes, ordinances and regulations of federal, state and municipal authorities having jurisdiction.

B. Manufacturer Requirements: Manufacturer shall have been in the business of and have experience in manufacturing wide span opening protective door assemblies as well as providing dependable credible service for a minimum of ten (10) years.

C. Operational Cycle Life: Tornado resistant coiling doors shall be designed and constructed for a minimum 10,000 operating cycles for the life of the door assembly. Cycles shall be verifiable by a non-resettable cycle counter located within the door’s motor operator control panel.

1.05 DELIVERY, STORAGE AND HANDLING

A. General: Deliver and store materials in manufacturer's original packaging, labeled to show name, brand and type. Store materials in a protected dry location off the ground in accordance with manufacturer's instructions.

1.06 WARRANTY

A. Tornado Resistant Coiling Door Warranty: Provide Two (2) Year, 10,000 Cycle Warranty signed by the manufacturer and installer agreeing to repair or replace work which has failed as a result of defects in materials or workmanship. Upon notification within the warranty period, such defects shall be repaired at no cost to the owner.

PART 2 PRODUCTS

2.01 TORNADO AND HURRICANE RESISTANT COILING DOORS

A. Manufacturer: Tornado resistant coiling doors shall be the model SafeSpace™ SS500X-PC as manufactured by McKEON. Assembly shall

be tested, listed and labeled by an IAS accredited nationally recognized testing laboratory, approved for use in FEMA 361 and ICC 500-2020 safe rooms and storm shelters.

2.02 MATERIALS

A. Curtain: Shall be assembled of light weight extruded alloy interlocking slats. Curtain shall be formed of EX slat profile sections of gauge thickness as required to sustain the minimum required design wind pressure.
   1. Slat cross section shall not be less than 3” wide by 1-1/8” deep.

B. Bottom Bar: Shall consist of a double 3” x 3” structural steel angle assembly formed to fit and engage the curtain assembly.

C. Guides: Each guide assembly shall be fabricated of structural steel support angles no greater than 4” x 4” and guide retaining angles of a minimum 6” depth to retain curtain in the guides under the design wind pressure and impact forces specified.

D. Mounting Brackets: Fabricated of hot rolled 3/16” minimum steel plates, brackets shall be provided to house ends of the counterbalance barrel assembly.

E. Hood: Shall be provided to entirely enclose coiled curtain and counterbalance barrel assembly. Hood shall be fabricated of a minimum 22 gauge G90 galvanized steel, designed and formed to match brackets. Top and bottom shall be bent and reinforced to provide for proper stiffness.

F. Counterbalance Assembly: Coiling door shall be counterbalanced by means of adjustable steel helical torsion springs attached to shaft enclosed in pipe with required mounting blocks or rings for attachment of curtain. Grease sealed bearings or self-lubricating graphite bearings shall be attached to the spring barrel which shall be fabricated of hot formed structural quality carbon steel seamless pipe.

G. Electric Motor Operator: Door shall be provided with a compact power unit designed and laboratory listed by the door manufacturer. Operator shall be equipped with an adjustable screw-type limit switch to break the circuit at termination of travel. High efficiency planetary gearing running in an oil bath, shall be furnished together with a centrifugal governor, magnetic operated brake and a fail-safe magnetic release device,

completely housed to protect against damage, dust and moisture. An efficient overload protection device, which will break the power circuit and protect against damage to the motor windings shall be integral with the unit. Operator is to be housed in a NEMA type 1 enclosure.

a. Motor: Shall be intermediate duty, thermally protected, ball bearing type with a class A or better insulation. Horsepower of motor is to be 1/2hp minimum or of manufacturer's recommended size, whichever is greater.
b. Starter: Shall be size "0" magnetic reversing starter, across the line type with mechanical and electrical interlocks, with 10 amp continuous rating and 24 volt control circuit.
c. Reducer: Planetary gear type, 80% efficiency minimum.
d. Cycle Counter: Non-resettable operational cycle counter.

H. NFS Operation: The operating system shall prevent the tornado storm door from closing during building power interruption to the motor operator for a period of up to six hours. Once the NFS cycle lapses, the door shall self-close at a controlled governed rate of closure not greater than 6" per second.

I. Control Stations: Each tornado storm door shall be provided with three position push button control station marked open, close and stop that is active during normal and alarm conditions. The control station shall remain operable as long as there is no main power failure to the motor operator.

J. Master Control Station: Provide a single master control station that can simultaneously activate all of the tornado storm doors in the facility to the emergency closed or open positions. The master control station shall remain operable as long as there is no main power failure to the door’s motor operators.

K. Emergency Alarm Activation: not applicable.

L. Emergency Manual Operation: The door assembly shall be equipped with an emergency hand chain that shall remain operable during an emergency alarm condition. The emergency hand chain shall also remain operable during main power failure lasting up to six hours, after the six hours have lapsed, the door assembly shall automatically self-close and remain in the closed position until main power has been restored to the motor operator. The hold open sequence of the emergency manual operation mode shall be programable so that during an emergency alarm condition or main power failure, not exceeding six hours, the door assembly shall

remain open for a period of five to thirty minutes after the hand chain has opened the door and before the door assembly begins to automatically self-close again.

M. Obstruction Sensing Safety Edge: The obstruction sensing safety edge shall be programable to either stop or reverse upon coming in contact with an obstruction during the close cycle of the door. The obstruction sensing safety edge shall remain active and operable as long as there is no main power failure to the motor operator. During main power failure, if the obstruction sensing safety edge comes in contact with an obstruction during the self-closing mode, the door shall stop and remain in contact with the obstruction until it is removed and the door can continue to the fully closed position.

N. True Test Panel: not applicable.

O. Finish: After completion of fabrication, clean all metal surfaces to remove dirt and chemically treat to provide for powder coat adhesion. Provide powder coat finish of color as selected by architect from manufacturer’s standard RAL powder coat selection chart.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces and field conditions to which this work is to be performed and notify architect if conditions of surfaces exist which are detrimental to proper installation and timely completion of work.

B. Verify all dimensions taken at job site affecting the work. Notify the architect in any instance where dimensions vary.

C. Coordinate and schedule work under this section with work of other sections so as not to delay job progress.

3.02 INSTALLATION

A. Perform installation using only factory approved and certified representatives of the coiling door manufacturer.

B. Install coiling door assemblies at locations shown in perfect alignment and elevation, plumb, level, straight and true.

C. Adjust coiling door installation to provide uniform clearances and smooth non-binding operation.

D. Install wiring in accordance with applicable local codes and the National Electrical Code Standard. Materials shall be UL listed.

3.03 PROTECTION AND CLEANING

A. Protect installed work using adequate and suitable means during and after installation until accepted by owner.

B. Remove, repair or replace materials which have been damaged in any way.

C. Clean surfaces of grime and dirt using acceptable and recommended means and methods.

End of Section

DIVISION 8 - DOORS AND WINDOWS

SECTION 08400 - ENTRANCES AND STOREFRONTS

PART 1 - General

1.01 Work Included:
- A. All materials, labor, services, and incidentals necessary for the completion of all work as shown on the Drawings and specified herein.
- B. All necessary anchors and accessories required for the complete installation of the Storefront units.
- C. Perimeter Sealant.

1.02 Related Work Specified Elsewhere:
- A. Sealants - Section 07900.
- B. Hardware and Specialties - Section 08700.
- C. Glazing - Section 08800.

1.03 Performance And Testing Requirements:
- A. Provision for Thermal Movements:
  1. Storefront framing systems shall be designed to provide for thermal movement of all component materials resulting from a cycling temperature range of 180 degrees F. without causing buckling, stresses on glass, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or other detrimental effects. Operating windows and doors shall function normally over this temperature range.
- B. Test Procedures and Performance:
  1. Air Infiltration Test, Fixed Unit:
     a. Test Fixed Unit in accordance with ASTM E 283 at static air pressure difference of 6.24 psf.
     b. Air infiltration shall not exceed .06 cfm per square foot of fixed wall area.
  2. Air Infiltration Test, Doors:
     a. Test Doors in accordance with ASTM E 283 at static air pressure difference of 1.57 psf.
     b. Air infiltration shall not exceed .10 cfm per foot of perimeter crack length for pair of doors.
  3. Water Resistance Test:
     a. Test unit in accordance with ASTM E 331.
     b. There shall be no uncontrollable water leakage at a static test pressure of 12.00 psf.
  4. Uniform Load Deflection Test:
     a. Test in accordance with ASTM E 330.
     b. Design and size members to withstand dead loads and live loads caused by pressure and suction of wind as calculated in accordance with 2018 International Building Code.
     c. Deflection under design load shall not exceed

L/175 of the clear span.

5. Uniform Load Structural Test:
   a. Test in accordance with ASTM 330 at a pressure 1.5 times the design wind pressure in 1.05B.3.b.
   b. At conclusion of the test, there shall be no glass breakage, permanent damage to fasteners, storefront parts, or any other damage which would cause the storefront to be defective.
6. Condensation Resistance Test (CRF):
   a. Test unit in accordance with AAMA 1503.1.
   b. Condensation Resistance Factor (CRF) shall be not less than 70.
7. Thermal Transmittance Test (Conductive U Value):
   a. Test in accordance with AAMA 1503.1.
   b. Conductive thermal transmittance (U Value) shall be not more than .44 BTU/HR/degree F/sf. Unless otherwise specified, units tested for condensation resistance and thermal transmittance shall be glazed with no more than two lites of clear, uncoated, annealed glass. Sealed insulating glass shall be of standard construction.

1.04 Quality Assurance:

A. Provide test reports from AAMA accredited laboratories certifying the performance as specified in 1.05.

B. Test reports shall be accompanied by the storefront manufacturer's letter of certification stating that the tested storefront meets or exceeds the referenced criteria for the appropriate storefront type.

1.05 Submittals:

A. Contractor shall submit shop drawings to the Architect for his approval. Drawings shall show scale elevations and sections. Full size sections shall be shown only when needed for clarity. Drawings shall show construction of all parts of the work, including metal and glass thickness, methods of joining, details of all field connections and anchorage, fastening and sealing methods, metal finishes and all pertinent information. Relationship to other work should be clearly indicated. No work shall be fabricated until shop drawings for that work have been finally approved for fabrication.

B. An NFRC Component Modeling Approach (CMA) generated label certificate shall be provided by the manufacturer. The label certificate shall be project specific and will contain the thermal performance ratings of the framing combined with the specified glass, and the glass spacer

used in the fabrication of the glass, at NFRC standard test size as defined in table 4-3 in the latest NFRC 100 regulations.

1.06 Delivery, Storage And Handling:

A. Deliver, handle, store and protect system components in accordance with manufacturer's instructions.

B. After erection, the Contractor shall adequately protect all exposed portions of the grid framing metal work from damage by grinding and polishing machines, plaster, lime, acid, cement, or other harmful compounds.

C. Immediately prior to final acceptance of building, inspect all aluminum framing for weather tightness and make all necessary repairs and adjustment.

1.07 Warranties:

A. Total Storefront System

1. The responsible contractor shall assume full responsibility and warrant for one year the satisfactory performance of the total storefront installation. This includes the framing, glass (including insulated units), glazing, anchorage and setting system, sealing, flashing, etc. as it relates to air, water and structural adequacy as called for in the specifications and approved shop drawings. A manufacturer’s material written warranty shall be provided for a minimum of 3 years from substantial completion for all items listed above except for glass which shall have a written warranty of 10 years.

2. Any deficiencies due to such elements not meeting the specifications shall be corrected by the responsible contractor during the warranty period.

1.08 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.**

PART 2 - PRODUCTS

2.01 Entrance and Storefront System:

A. EFCO Corporation S-406 Wall Thermal Storefront System, with Series D318 DuraStyle Wide Style aluminum entrance doors.

B. Finish – clear anodized aluminum. Coordinate with Architect.

2.02 Material:

A. Aluminum:

1. Extruded aluminum shall be 6063-T6 alloy and temper.

B. Glass:
1. Glass for Fixed Sidelite Units shall be according to Glazing Schedule.

Glass for Entrance Doors shall be 1 inch thick insulated tempered glass units - factory glazed.

Glass for Metal Windows – refer to Section 08500 Metal Windows and Section 08810 Insulating Glass Panels.

C. Thermal Barrier:
1. The thermal barrier material shall be a poured-in-place, two-part polyurethane system. **A nonstructural thermal barrier is unacceptable.**

D. Dissimilar Metals:
1. All dissimilar metals must be properly insulated to prevent galvanic action.

E. Fasteners:
1. All exposed fasteners shall be aluminum or stainless steel.

2.03 Fabrication - Fixed Units:

A. General:
1. All aluminum frame extrusions shall have a minimum wall thickness of .080 inches.
2. All exposed work shall be carefully matched to produce continuity of line and design with all joints. System design shall be such that raw edges will not be visible at joints.

B. Frames - for 1" glazing:
1. Depth of frame shall not be less than 6.5 inches.
2. Face dimension shall not be less than 2 inches
3. Covers shall connect to frame back members with internally connected and locked celcon insulator clips.
4. Frame components shall be screw spline construction. Door frames shall be shear block construction.

C. Glazing
1. All units shall be “dry” glazed with E. P. D. M. gasket on both exterior and interior.

2.04 Fabrication - Entrance Doors:

A. General:
1. Major portions of the door sections shall have .188” wall thickness.
2. Glazing stop sections shall have .050” wall thickness.

B. Entrance Doors:
1. Door stiles shall be no less than 6” wide (not including glass stops).

2. Door stiles and rails shall have hairline joints at corners. Heavy concealed reinforcement brackets shall be secured with screws and shall be deep penetration and fillet welded.
3. All doors shall have an adjusting mechanism in the top rail to provide for minor clearance adjustments.
4. Weather-stripping shall be wool pile and shall be installed and shall be installed in one stile of pairs of doors and in jamb stiles of center pivoted doors.
5. Door stops shall include wool pile weather-stripping.

C. Glazing:
1. All units shall be dry glazed with extruded pressure fitting aluminum glazing stops, and E.P.D.M. gasket.

D. Door Frame:
1. Depth of frame shall not be less than 6”.
2. Face dimension shall not be less than 2”.
3. Shear block construction shall be utilized through out. System design shall be such that raw edges will not be visible at joints.

2.05 Finish:

A. Finish – clear anodized aluminum. Coordinate with Architect.

PART 3 EXECUTION

3.01 Inspection:

A. Job Conditions:
1. All openings shall be prepared to the proper size and shall be plumb, level and in the proper location and alignment as shown on the Drawings.

3.02 Installation:

A. Use only skilled tradesmen with work done in accordance with approved shop drawings and specifications.

B. Storefront system shall be erected plumb and true, in proper alignment and relation to established lines and grades.

C. Entrance doors shall be securely anchored in place to a straight, plumb and level condition, without distortion. Weather-stripping contact and hardware movement shall be checked and final adjustment made for proper operation and performance of units.

D. Furnish and apply sealing materials to provide a weather tight installation at all joints and intersections and at opening perimeters.

E. Sealing materials specified shall be used in strict accordance with the manufacturer>s printed instructions and

shall be applied only by mechanics specially trained of experienced in their use. All surfaces must be clean and free of foreign matter before applying sealing materials. Sealing compounds shall be tooled to fill the joint and provide a smooth finished surface.

3.03 Anchorage:

A. Adequately anchor to maintain positions permanently when subjected to normal thermal movement, specified building movement, and specified wind loads.

3.04 Protection and Cleaning:

A. The general contractor shall protect the aluminum materials and finish against damage from construction activities and harmful substances. The contractor shall remove any protective coatings as directed by the Architect and shall clean the aluminum surfaces as recommended for the type of finish applied.

End of Section

SECTION 08500 - METAL WINDOWS

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this section of the work.
- B. All necessary anchors and accessories required for complete installation of the window frame units.
- C. Caulking; refer to part 3 for special caulking requirements.

1.02 Related Work Specified Elsewhere:
- A. Sealants - Section 07900.
- B. Insulating Glass Panels - Section 08810.

1.03 Quality Assurance:
- A. Test Units:
  1. Air, water and structural tests shall conform to requirements set forth in ANSI/AAMA 101/I.S.2-97 or 101-93 AW Grade.
  2. Thermal test unit sizes shall be 4'-0" x 6'-0".
- B. Test Procedures and Performances Windows:
  1. Shall conform to all ANSI/AAMA 101/I.S.2-97 or 101-93 AW Grade requirements. In addition, the following specific performance requirements shall be met.
  2. Air Infiltration Test:
     a. With window sash closed and locked, test unit in accordance with ASTM E 283 at a static air pressure difference of 1.57 psf or 6.24 psf AW Grade.
     b. Air infiltration shall not exceed .10 cfm per foot of perimeter crack length.
  3. Water Resistance Test:
     a. With window sash closed and locked, test unit in accordance with ASTM E 331/ASTM E 547 at a static air pressure difference of 7.50 psf or 10.0 psf AW Grade.
     b. There shall be no uncontrolled water leakage.
  4. Uniform Load Structural Test:
     a. With window sash closed and locked, test unit in accordance with ASTM E 330 at a static air pressure difference of 97.50 psf positive pressure and 75.00 psf negative pressure.
     b. At conclusion of test there shall be no glass breakage, permanent damage to

fasteners, hardware parts, support arms or actuating mechanisms, nor any other damage which would cause the window to be inoperable.

5. Condensation Resistance Test (CRF):
   a. With window sash closed and locked, test unit in accordance with AAMA 1503.1-1988.
   b. Condensation Resistance Factor (CRF) shall not be less than 46.
6. Thermal Transmittance Test (Conductive U-Value):
   a. With window sash closed and locked, test unit in accordance with AAMA 1503.1-1988.
   b. Conductive thermal transmittance (U-value) shall not be more than .66 BTU/hr/sf/degrees F.

1.04 Submittals:

A. Shop Drawings: Showing elevations, sections of members, sizes and thickness, details of construction, and installation and erection details. Do not begin fabrication until receiving approved shop Drawings.

B. Documentation shall be submitted showing the window units meet or exceed all requirements of the testing listed under 1.03 above. Test results shall be included.

1.05 Product Delivery, Storage and Handling:

A. After erection, the Contractor shall adequately protect all exposed portions of the window framing metal work from damage by grinding and polishing machines, plaster, lime, acid, cement, or other harmful compounds.

B. Immediately prior to final acceptance of building, inspect all aluminum framing for weather tightness and make all necessary repairs and adjustment.

1.06 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.**

Part 2 - Products

2.01 Window System:

A. EFCO Series 6620, fixed window units.

2.02 Finishes: Refer to color schedule – clear anodized aluminum.

2.03 Fabrication:

A. The aluminum framing system shall employ continuous head and sill. All extruded aluminum shall be 6063-T5 or T6 alloy. Depth of frame and sash shall be not less than 3-7/8".

B. Thermal Barrier:
   1. Barrier material shall be poured-in-place two part polyurethane. A nonstructural thermal barrier is unacceptable.

C. Glazing: Units shall be glazed with Insulating Glass Panels as per Section 08810.

D. Accessories: provide all components including - but not limited to - sub-sill, sub-frame, etc. as necessary for a complete and watertight installation.

E. Seals against moisture intrusion as recommended by the window and glazing manufacturers.

Part 3 - Execution

3.01 Installation:

A. All items under this heading shall be set in their correct locations as shown in the details and shall be level, square, plumb, and at proper elevations and in alignment with other work.

B. Sealant shall be applied as required at all points between wall and the aluminum outer frame. The sealant material shall be applied in a manner to ensure air-tight and water-tight continuous perimeter seal, to prohibit the seepage of cold air into the insulated outside cavity.

C. Install in accordance with approved shop drawings and manufacturer's recommendations.

3.02 Cleaning:

A. The Contractor shall be responsible for removal of protective materials and cleaning of the aluminum.

B. All aluminum shall be thoroughly cleaned with plain water, or water with soap or household detergent.

End of Section

SECTION 08700 - FINISH HARDWARE

Part 1 - General

1.01 Work Included:
- A. All materials, labor services and incidentals necessary for the completion of this section of the work.

1.02 Related Work Specified Elsewhere:
- A. Finish Carpentry - Section 06200
- B. Custom Laminate Casework - Section 06420
- C. Metal Doors and Frames - Section 08100
- D. Wood Doors - Section 08200
- E. Tornado Resistant Coiling Doors – Section 08330

1.03 Quality Assurance:
- A. This material shall be procured from a source of supply approved by the Architect as having a member of their firm registered by the American Society of Contracting Architectural Hardware Consultants, and with a proven record of several years of satisfactory experience in contract builder's hardware, both in furnishing material and properly servicing jobs. The supplier also must be an established contract builder's hardware firm who meets all the above requirements, and who maintains

1.04 Submittals:
- A. Prepare a complete schedule including all items processed for each opening and other miscellaneous items and submit four copies to the Architect for approval within 30 days submitted within that time, the supplier shall furnish the hardware specified by catalog number.
- B. Indicate on schedule name of manufacturer after each item.
- C. Upon receiving the approved schedule, the hardware supplier shall immediately forward a copy to the metal frame suppliers, when applicable; and as soon as they receive approved shop drawings, they will immediately forward a complete set to the hardware supplier who can then check the applications and make any necessary minor revisions. If revisions are necessary, notify Architect immediately.
- D. Mark each item of hardware for opening on which it is to be used and deliver a complete schedule to the contractor when hardware is delivered.

1.05 Schedule:
- A. This specification describes the quality, character and function that is required of items of hardware; however, it is not intended to mention each particular item.
- B. It is the responsibility of the supplier to thoroughly detail the entire project to assure that the items specified will properly function in the indicated locations.
- C. Quantities shall be determined by the bidder. Part 2, following, indicates the type and function of material applicable to the typical opening. Should an unlisted opening require different type of function of hardware than that specified, for similar opening, notify the Architect, and provide hardware for unlisted openings within the bid.

SECTION 08700 - FINISH HARDWARE

Part 2 - Products

2.01 Finish Hardware:

A. Standards of Quality:

1. Codes, specifications and published recommendations, latest editions of the following are hereby made part of this section of the specifications in so far as they apply to the material or work called for.
   a. National Builders Hardware Association (NBHA)
   b. American Society for Testing Materials (ASTM)
   c. Underwriters Laboratories (UL)
   d. National Fire Protection Association (NFPA)
   e. Code of Ethics of ASAHC & NBHA
   f. Federal Emergency Management Agency (FEMA)
2. Federal Specification, (ANSI Specifications):
   a. Hinges: FF-H-116C (ANSI A156.1)
   b. Locks and Door Trim: FF-H-106A (ANSI A 156.2)
   c. Auxiliary Locks: FF-H-106A (ANSI A 156.5)
   d. Exit Devices: FF-H-106A, FF-H-111B, FF-L486 (ANSI A156.3).
   e. Door Closers: FF-H-121C (ANSI A 156.4)
   f. Shelf and Miscellaneous Hardware: FF-H-00116 (ANSI A156.6).
   g. All Door hardware: Comply with ADAAG where applicable.

B. General:

1. All hardware relating to hollow metal doors and frames shall be to standard templates of each respective hardware manufacturer for items furnished.
   a. The related suppliers such as hollow metal doors and frames and such others as may be required will furnish the hardware supplier one copy of each of their approved shop drawings for proper coordination of their work and the finish hardware.

C. Manufacturers and Requirements:

1. Hardware manufacturers and brand names are for a guide as to type and standard required and all such hardware furnished must meet these standards as far as quality, weight, finish and design.

D. Keying:

1. All locks and cylinders to be masterkeyed as directed by the Architect/Owner.
2. Keys: Furnish the following keys:
   a. 2 change keys each lock or cylinder
   b. 6 masterkeys
   c. all EXTERIOR locks and cylinders shall be Primus Schlage Key System and keyed to Owner's Primus Master Key system. All remaining interior locks and cylinders shall be Classic Schlage and keyed to the Owner's Primus Master Key System.

2.02 Hardware Sets:

Hardware Group No. T1:

Refer to Section 08330 Tornado Resistant Coiling Doors.

Hardware Group No. T2:

Refer to Section 08310 Tornado Doors.

Hardware Group No. 001: Provide each PR door(s) with the following:

Quantity		Description	Model Number	Finish	Mfr
2	EA	PIVOT SET	7215 SET	626	IVE
2	EA	PIVOT	7215 INT	626	IVE
1	EA	MULLION	KR4954 HEIGHT AS REQUIRED	689	VON
1	EA	PANIC HARDWARE	CD99EO LENGTH AS REQUIRED	626	VON
1	EA	PANIC HARDWARE	CD99NL-OP LENGTH AS REQUIRED	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
3	EA	MORTISE CYLINDER	20-061 ICX	626	SCH
4	EA	PRIMUS CORE ONLY	20-740	626	SCH
2	EA	OFFSET DOOR PULL	8190-0-O	630	IVE
2	EA	SURFACE CLOSER	4041 SCUSH MTG BRKTS, SPCRS & PLATES AS REQ	689	LCN
2	EA	DOOR SWEEP	C627A LENGTH AS REQUIRED	AL	NGP
1	EA	THRESHOLD	896V LENGTH AS REQUIRED	AL	NGP
1	MEETING STYLE SEAL BY DOOR MANUFACTURER				
1	PERIMETER SEAL BY DOOR MANUFACTURER				
	REFER TO ELECTRICAL FOR ACCESS, CARD READER, ETC. INFORMATION.				

Hardware Group No. 002: Provide each PR doors with the following:

Quantity		Description	Model Number	Finish	Mfr
2	EA	CONTINUOUS HINGE	224HD HEIGHT AS REQUIRED	628	IVE
1	EA	MULLION	KR4954 HEIGHT AS REQUIRED	689	VON
1	EA	PANIC HARDWARE	CD99EO LENGTH AS REQUIRED	626	VON
1	EA	PANIC HARDWARE	CD99NL-OP LENGTH AS REQUIRED	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
3	EA	MORTISE CYLINDER	20-061 ICX	626	SCH
4	EA	PRIMUS CORE ONLY	20-740	626	SCH
2	EA	OFFSET DOOR PULL	8190-0-O	630	IVE
2	EA	SURFACE CLOSER	4041 SCUSH MTG BRKTS, SPCRS & PLATES AS REQ	689	LCN
	REFER TO ELECTRICAL FOR ACCESS, CARD READER, ETC. INFORMATION.				

SECTION 08700 - FINISH HARDWARE

Hardware Group No. 003: Provide each SGL door(s) with the following:

Quantity		Description	Model Number	Finish	Mfr
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8303EZ-0 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP OR P4041H MTG BRKTS, SPCRS & PLATES AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	EA	STOP	WS407CCV OR FS436 AS REQUIRED	628	IVE
1	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 004: Provide each SGL door(s) with the following:

Quantity		Description	Model Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY SET	L9444 03N	626	SCH
1	EA	WALL STOP	WS407CCV OR FS436 AS REQUIRED	628	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 005: Provide each SGL door(s) with the following:

Quantity		Description	Model Number	Finish	Mfr
1	EA	CONTINUOUS HINGE	224HD HEIGHT AS REQUIRED	628	IVE
1	EA	PANIC HARDWARE	CD99NL-OP LENGTH AS REQUIRED	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	MORTISE CYLINDER	20-061 ICX	626	SCH
1	EA	PRIMUS CORE ONLY	20-740	626	SCH
1	EA	OFFSET DOOR PULL	8190-0-O	630	IVE
1	EA	SURFACE CLOSER	4041 OR P4041 MTG BRKTS, SPCRS & PLATES AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	EA	STOP	WS407CCV OR FS436 AS REQUIRED	628	IVE
1	EA	DOOR SWEEP	C627A LENGTH AS REQUIRED	AL	NGP
1	EA	THRESHOLD	896V LENGTH AS REQUIRED	AL	NGP
1	SET	SEALS	700SA H & J (INSTALL PRIOR TO OTHER HARDWARE)	AL	NGP
1	EA	OVERHEAD RAIN DRIP	16A DW + 4"	AL	NGP

Hardware Group No. 006: Provide each SGL door(s) with the following:

Quantity		Description	Model Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE LOCK	L9050T 03N	626	SCH
1	EA	CLASSIC CORE	23-030	626	SCH
1	EA	STOP	WS407CCV OR FS436 AS REQUIRED	628	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	SURFACE CLOSER	4041 OR P4041 MTG BRKTS, SPCRS & PLATES AS REQ	689	LCN

SECTION 08700 - FINISH HARDWARE

Hardware Group No. 007: Provide each SGL door(s) with the following:

Quantity		Description	Model Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 03N	626	SCH
1	EA	CLASSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4041 OR P4041 MTG BRKTS, SPCRS & PLATES AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	STOP	WS407CCV OR FS436 AS REQUIRED	628	IVE
1	SET	SEALS	5050BR H & J (USE SILENCERS @ NON-RATED DOORS)	CLR	NGP

Hardware Group No. 008: Provide each PR door(s) with the following:

Quantity		Description	Model Number	Finish	Mfr
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	AUTO FLUSH BOLT	FB31P OR FB41P AS REQUIRED	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 03N	626	SCH
1	EA	CLASSIC CORE	23-030	626	SCH
1	EA	COORDINATOR	COR X FL X MTG BRKTS X HW PREPS X LENGTH AS REQ	628	IVE
1	SET	ASTRAGAL	9605A HEIGHT AS REQ (OMIT @ NON-RATED DOORS)	AL	NGP
2	EA	SURFACE CLOSER	4041 OR P4041 MTG BRKTS, SPCRS & PLATES AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
2	EA	STOP	WS407CCV OR FS436 AS REQUIRED	628	IVE
1	SET	SEALS	5050BR H & J	CLR	NGP

Hardware Group No. 009: Provide each PR door(s) with the following:

Quantity		Description	Model Number	Finish	Mfr
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	AUTO FLUSH BOLT	FB31P OR FB41P AS REQUIRED	630	IVE
1	EA	CLASSROOM LOCK	L9070T 03N	626	SCH
1	EA	CLASSIC CORE	23-030	626	SCH
1	EA	COORDINATOR	COR X FL X MTG BRKTS X HW PREPS X LENGTH AS REQ	628	IVE
1	SET	ASTRAGAL	9605A HEIGHT AS REQ (OMIT @ NON-RATED DOORS)	AL	NGP
2	EA	SURFACE CLOSER	4040XP OR P4041 MTG BRKTS, SPCRS & PLATES AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
2	EA	STOP	WS407CCV OR FS436 AS REQUIRED	628	IVE
1	SET	SEALS	5050BR H & J (USE SILENCERS @ NON-RATED DOORS)	CLR	NGP

SECTION 08700 - FINISH HARDWARE

Hardware Group No. 010: Provide each SGL door(s) with the following:

Quantity		Description	Model Number	Finish	Mfr
1	EA	CONTINUOUS HINGE	224HD HEIGHT AS REQ	628	IVE
1	EA	COMMUNICATING LOCK	L9025 03N	626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	SET	SEALS	700SA H & J (INSTALL PRIOR TO OTHER HARDWARE)	AL	NGP
1	EA	DOOR STOP	WS407CCV OR FS436 AS REQUIRED	628	IVE

The following list of products and manufactures are acceptable for this project.

Product	Manufacture and Approved Equals
1. Hinges	A. Ives B. Hager C. Bommer
2. Continuous Hinges	A. Pemko B. Roton C. Select
3. Key System	A. **Schlage (No substitutions)**
4. Lock/Latch	A. **Schlage (No substitutions)**
5. Closers	A. **LCN (No substitutions)**
6. Exit Devices	A. **Von Duprin (No substitutions)**
7. Push/Pull/Plates	A. Ives B. Rockwood C. Trimco
8. Misc. Stop, Bolts, etc.	A. Ives B. Glynn-Johnson C. Rockwood
9. Door Seal/Thresholds	A. National Guard B. Pemko C. Reese

Each Product, by category, shall be the product of one manufacture. Complete lockset, including keyed lock cylinder, shall be the product of one manufacturer unless noted otherwise.

Part 3 - Execution

3.01 Installation:

A. Install all finish hardware in strict accordance with the manufacturer's recommendations and printed instructions.

Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, install each item completely and then remove and store in the a secure place during the finish application. After completion of the finishes, reinstall each item. Do not install surface mounted items until finishes have been completed on the substrate.

B. All hardware relating to hollow metal and aluminum doors and frames shall be to standard templates of each respective hardware manufacturer for items furnished.

C. Mounting Heights: Mount Hardware units at heights recommended by the National Builders Hardware Association, except as specifically indicated or required to comply with governing regulations, or as may be otherwise directed by the Architect.

3.02 Prior to the Final Inspection:

A. The supplier shall check all closers for proper operation after they have been installed and adjusted by the Contractor. He shall verify the keying to insure proper location of locksets and shall assist the Contractor in correcting faulty operation of any locks.

B. Within 30 days after the acceptance of the entire project, the Contractor shall be responsible for this supplier meeting with the maintenance custodian at the job site for the purpose of instructing him thoroughly in the proper repair and adjustment of all finish hardware items, and items, and shall present to the custodian a full complement of tools to be used.

End of Section

DIVISION 8 - DOORS AND WINDOWS

SECTION 08800 - GLAZING

Part 1 - General

1.01 Work Included:
- A. The General Conditions and applicable sections of Division 1 shall apply to this entire section.
- B. All materials, labor, services, and incidentals necessary for the completion of this section of the work.

1.02 Quality Assurance:
- A. Standards:
  1. Federal Specifications
     a. DD-G-451d, Glass, Plate, Sheet (for glazing and other uses).
  2. Flat Glass Jobber Association: Glazing Manual.
- B. Comply with UBC 2406, and ANSI 97.1 with testing requirements of 16 CFR 1201, Cat II.

1.03 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.**

Part 2 - Products

2.01 Materials – Glass and associated accessories:
- A. Glass Types and Examples:
  1. 1/4" Tempered Glass:
     a. Type example: 1/4" Clear Herculite - PPG.
  2. 1" Nominal Thickness Insulating Tempered Glass - 1/4" tinted glass @ exterior side and 1/4" 100 Low E glass @ interior side of 2" air space - **both sides tempered.** Low Emissivity coating on 3rd glass surface from building exterior.
     a. Type Example: Versalux Green 2000 Insulated with Low-E, Visteon (Ford). **Note: Color will be a factor in approval.**
- B. Glazing Compounds and Preformed Glaze Sealants: Suitable type as approved for the installation, in accordance with Glazing Materials section of the FGJA Glazing Manual.
- C. Glazing Accessories: Provide miscellaneous materials such as cleaners, primers, setting blocks, spacers, filler rods, beads, etc., as required for complete installation.

Part 3 - Execution

3.01 Installation:
- A. Glazing-General:

SECTION 08800 - GLAZING

1. Items to be glazed may be field-or shop-glazed, using glass of the quality and thickness specified or indicated. Preparation of surrounds and glazing, unless otherwise specified, shall be in conformance with the details and general conditions governing glazing in the FGMA Glazing Manual, beads or stops which are furnished with the items to be glazed shall be used to secure the glass in place.
2. All glass shall be set with the waves parallel to the sill. Glass that has been misordered, i.e. with the width and height dimensions not properly correlated with the Drawing process in manufacturing, resulting in pronounced waviness at right angles to the sill, will be rejected.
3. Install plastic glass edging strips where indicated. Joints shall be as tight and imperceptible as possible.

B. Breakage: Replace all glass broken during or after setting. Breakage due to accident or carelessness or other will be charged to trade at fault.

C. Inspection: Prior to final acceptance of project, inspect all work done under this section and make all necessary adjustments, repairs, or replacements of defective work, and clean all glass surfaces.

D. Clean-up: Remove all glass cuttings, scraps, packaging and rubbish upon completion of the work.

End of Section

SECTION 08810 – INSULATING GLASS PANELS

PART 1 - GENERAL

1.01 - Scope

1. The Panels required are as manufactured by Mapes Architectural Panels, LLC, Lincoln, NE. Panels consist of metal skins laminated to stabilizer substrates with an insulating core material. Panels are designed to be glazed into a window system or curtain wall system.
2. Related Work
    1. Section 04810 – Masonry Assemblies
    2. Section 05120 - Structural Steel
    3. Section 07150 - Dampproofing
    4. Section 07200 - Insulation
    5. Section 07600 - Metal Flashing
    6. Section 07900 - Sealants
    7. Section 08500 - Windows

1.02 - Quality Assurance

1. Panel manufacturer shall have a minimum of 25 years of experience.
2. Field measurements shall be taken prior to completion of manufacturing and cutting.
3. Maximum deviation from vertical and horizontal alignment of installed panels is 1/8" (3mm) in 20' (6m) non-commutative.

1.03 - References

1. American Society of Testing Materials (ASTM)
    A. E330-84: Structural Performance of Exterior Windows, Curtain Walls and Doors under the influence of wind loads.
    B. D1781-76: Climbing Drum Peel Test for Adhesives.
    C. D3363-74: Method for Film Hardness by Pencil Test.
    D. D2794-90: Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
    E. D3359-90: Method for Measuring Adhesion by the tape test.

1.04 - Substitutions

1. The materials and products specified in this section establish a minimum standard of required function, design, appearance quality and warranty to be met by any proposed substitution.
2. No substitutions will be considered unless a written request for approval has been submitted by the bidder and received by the architect 10 days prior to the bid date.

SECTION 08810 – INSULATING GLASS PANELS

1.05 - Submittals

1. Submittals shall be in conformance with the Special Conditions. Included section number of Division and refer to CSI Division I, Section 1340 - Shop Drawings, Product Data and Samples.
2. Samples:
   A. Panel makeup - 2 samples - 10"x10"
   B. Two samples of each color and finish texture - 3"x5"
3. Submission Drawings: Indicate thickness, dimension and components of parts. Detail glazing methods, framing and tolerances to accommodate thermal movement.
4. Affidavit certifying materials meet all requirements as specified.
5. 2 copies of manufacturers standard literature for specified material.

1.06 - Delivery, Storage and Handling

1. Protect finish and edge in accordance with panel manufacturer's recommendations.
2. Store materials in accordance with panel manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 - Panels - Laminated

1. Laminated metal faced MapeSpan panels as manufactured by Mapes Industries, Inc.
2. Acceptable alternatives: Panels having similar composite construction and finish providing manufacturer has a minimum of 25 years panel laminating experience and comparable published warranties.

2.02 - Finish

1. Finishes
2. Exterior: Exterior Spandrel Glass
3. Interior: Standard Kynar
4. Color as selected by architect.

2.03 - Panel Fabrication

1. Exterior Substrate: N/A
2. Core: Isocyanurate
3. Interior Substrate: Cement Board
4. Tolerances - .8% of panels dimension length and width - (+/-) 1/16" thickness
5. Panel Thickness - 1"
6. R-Value - 5.73

7. U-Value - 0.17

2.04 - Accessories

1. Recommended for use as an infill panel component in window and curtain wall systems. Related material to complete installation as recommended by the manufacturer.
2. Seals against moisture intrusion as recommended by the manufacturer. Polyurethane and silicone based sealant with a 20 year life are recommended.

PART 3 - EXECUTION

3.01 - Installation

1. Panel surfaces shall be free from defects prior to installation.

3.02 - Execution

1. Erect panels plumb, level and true.
2. Glaze panels securely and in accordance with approved shop drawings and manufacturer's instructions to allow for necessary thermal movement and structural support.
3. Do not install panels that are observed to be defective including warped, bowed, dented, scratched and delaminating components.
4. Weatherseal all joints as required using methods and materials as previously specified.
5. Separate dissimilar metals using gasketed fasteners and blocking to eliminate the possibility of electrolytic reaction.

3.03 - Adjusting and Cleaning

1. Remove masking film as soon as possible after installation. Masking intentionally left in place after panel installation will be the responsibility of the contractor.
2. Weep holes and drainage channels must be unobstructed and free from dirt and sealant.

DIVISION 9 - FINISHES

SECTION 09120 - CEILING SUSPENSION SYSTEMS

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this section of the work.

1.02 Related Work Specified Elsewhere:
- A. Gypsum Wallboard - Section 09250
- B. Acoustical Treatment - Section 09500

1.03 Quality Assurance:
- A. Standards:
  1. American Society for Testing and Materials
     - a. ASTM C-635, Metal Suspension Systems for Acoustical Tile and Lay-In-Panel Ceilings.
     - b. ASTM C-636, Recommended Practice of Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In-Panels.
  2. All materials to comply with NFPA 101, 16-3.3.2, where applicable.
- B. Submittals:
  1. Provide submittals in the form of samples, and documentation, to the Architect for review.

1.04 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.**

Part 2 - Products

2.01 Materials:
- A. Suspended Acoustical Ceiling - Exposed Grid: ASTM C-635, intermediate structural classification.
  1. Main Beams, Cross Tees and Concealed Members: .015 cold rolled zinc coated steel.
  2. Wall Angle: .020 cold rolled zinc coated steel.
  3. Special Members: Provide special shaped members as shown on the Drawings.
  4. Member Finish: Exposed surfaces shall be flat white low-gloss grid.
  5. Hanger Wire: No. 12 gauge cold drawn, annealed, galvanized.
  6. Accessories: Provide wall clips, hold-down clips (shall be removable without damage to boards; two each panels opposite sides), beam clamps leveling splines, hanger clips, splice plates), (keep to a minimum), for a complete installation.

7. Acceptable Manufacturer: 200 Snap-Grid System, Chicago Metallic Corporation
8. Acoustical ACloud@ Edge Trim:
   a. Axiom Classic Trim as manufactured by Armstrong World Industries, Inc.
   b. Commercial quality extruded aluminum alloy 6063 trim channel with factory applied baked polyester paint finish.
   c. Color - white (to match ceiling grid).
   d. Height - 8".
   e. Provide all necessary accessories including, but limited to, corner posts, T-bar connection clips, galvanized steel splice plates, etc. Do not hang acoustical clouds from edge trim.

B. Suspended Gypsum Board Ceilings:
1. Structural Channels: Cold-rolled, 16 gauge, galvanized steel.
2. Furring Channels: Roll-formed, hat sections, 20 gauge.

Part 3 - Execution

3.01 General:

A. Coordinate with electrical and mechanical contractors in placement of light fixtures, grilles, etc. to conform with ceiling pattern.

B. Construct necessary scaffolding, adequate and safe, in accordance with applicable laws and ordinances. Maintain during this work and remove after completion.

C. Provide thorough and competent foreman and skilled mechanics.

3.02 Installation:

A. Suspended Acoustical Ceiling:
1. Deflection of any component shall not exceed 1/360 of the span.
2. Main tees shall be suspended on 48" centers by 12 gauge wire spaced not more than 48" o.c. along main tee.
3. Cross tees shall be placed at 24" o.c. or as required by the Drawings.
4. Install wall angles at intersection of suspended ceiling and all vertical surfaces. Miter corners where wall molding intersects.
5. Install grid system and ceiling panels with faces in a plane.
6. Provide intersection clips at intersection of all tees.
7. Provide additional hangar wire at four corners of light fixtures.
8. Provide additional hangar wires to insure proper placement

and alignment of grid system.

9. Prior to the final acceptance of the building, examine and adjust water level to be certain that all planes and lines are plumb, square and smooth. Replace all marked, marred or otherwise damaged materials.

B. Suspended Gypsum Board Ceilings:

1. Coordinate location of hangars with other work.
2. Install ceiling framing independent of walls, columns and above ceiling work.
3. Install ceiling framing system in accordance with manufacturer's recommendations.
4. Reinforce openings in ceilings in accordance with manufacturer's recommendations.
5. Laterally brace entire suspension system where required.

3.03 Clean-Up:

A. Completely remove from the job site, at the completion of the work, all cartons, packaging, etc., and all other scraps and waste caused by this trade.

End of Section

DIVISION 9 - FINISHES

SECTION 09250 - GYPSUM WALLBOARD

Part 1 - General

1.01 Work Included:
A. All materials, labor, services and incidentals necessary for the completion of this section of the work.

1.02 Quality Assurance:
A. Standards:
1. American Society for Testing and Materials:
a. ASTM C-36, Gypsum Wallboard
b. ASTM C-475, Joint Treatment for Gypsum Wallboard Construction.
B. Federal Specifications:
1. FS-SS-L-30D, Type III, Grade X, Class 1, Gypsum Wallboard.

1.03 Submittals:
A. Provide submittals in the form of samples, and documentation, to the Architect for review.

1.04 Product Delivery, Storage and Handling:
A. All materials shall be delivered to the job site with manufacturer's labels intact and stored in an enclosed shelter providing protection from damage and exposure to the elements.

Part 2 - Products

2.01 Gypsum Wallboard:
A. Type: **Fire-rated**, ASTM C-36.
B. Size: 5/8" thick x 48" wide x 96" or as required.
C. Edges: Tapered.
D. Location: All gypsum board.

2.02 Fasteners:
A. Screws: Self-drilling, self-tapping, bugle head, Type S.
B. Nails: Annular ring: GWB-54.

2.03 Joint Treatment Materials:
A. Joint Tape: Perforated Tape, ASTM C-475.
B. Joint Compound: ASTM C-475.

2.04 Accessories:
A. Metal Edge: Similar to United States Gypsum Trim No. 402.

Part 3 - Execution

3.01 Installation:
A. Apply gypsum board to horizontal surfaces first, then to vertical.
B. Install gypsum board parallel to studs at vertical surfaces.
C. To minimize joints, use panels of maximum practical lengths.
D. Position all ends and edges of gypsum board over nailing or fastening members. Fit ends and edges closely; do not force

together. Stagger end joints.

E. Cut ends, edges, scribe or make cutouts within field of panel in a workmanlike manner.

F. Install trim at all intersections of gypsum board and other surfaces. Provide corner bead at all vertical or horizontal corners.

G. Fasteners:

1. Drive fasteners in field of panel first, work toward ends and edges.
2. Perimeter fasteners shall be a least 3/8" from ends and edges.
3. Attach panels to wood framing members with specified nails spaced out 8" for ceiling, and 8" o.c. at ends and 12" o.c. at each support.
4. Drive nail head slightly below surface of panel in a uniform dimple without breaking face paper.
5. Screw fasteners shall be spaced 12" o.c. at each support in the field of the board and 8" o.c. at all edges and ends.
6. Screws shall be power-driven with an electric screwdriver and screw heads shall provide a slight depression below surface of panel without breaking face paper.

3.02 Joint Treatment:

A. Treat all exposed joints and trim with a three-coat approved system applied in strict accordance with manufacturer's recommendations.

3.03 Clean-Up:

A. Use all necessary care during execution of the Work of this Section to prevent undue scattering of drywall scraps and dust and to prevent tracking of joint and finishing compounds onto floor surfaces. On completion of each installation segment in a room or space, promptly pick up and remove from the working area all scraps, debris and surplus material.

End of Section

DIVISION 9 - FINISHES

SECTION 09300 - TILE

Part 1 - General

1.01 Work Included:
- A. All materials, labor services and incidentals necessary for the completion of this section of the work.

1.02 Quality Assurance:
- A. Standards:
  1. Tile Council of America:
     a. Handbook for Ceramic Tile Installation.
  2. American National Standards Institute:
     a. ANSI A108.6, Ceramic Tile installed with Epoxy Mortar.
     b. ANSI A108.4, Ceramic Tile installed water-resistant organic adhesive.
     c. ANSI A108.5, Ceramic Tile installed with latex Portland Cement.
     d. ANSI A118.4, Latex Portland Cement Mortar.
     e. ANSI A118.3, Epoxy Mortar and Grout.
     f. ANSI A136.1, Type 1 Organic Adhesive.
     g. ANSI A137.1, Ceramic Tile.
     h. ANSI A137.3, Porcelain Tiles and Porcelain Tile Panels/Slabs
  3. American Society for Testing and Materials:
     a. ASTM C-144, Aggregate.
     b. ASTM C-150, Portland Cement, Type 1.
     c. ASTM C-206, Special Finish Hydrated Lime.
- B. All materials shall meet IBC 2009, where applicable.
- C. Floor surfaces and elevation changes shall comply with ADAABAAG 302 and 303.
- D. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
  1. Level Surfaces: Minimum.
  2. Step Treads: Minimum.
  3. Ramp Surfaces: Minimum.
- E. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
  1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- F. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- G. Source Limitations for Other Products: Obtain each of the

following products specified in this Section from a single manufacturer for each product:
1. Stone thresholds.
2. Joint sealants.
3. Cementitious backer units.
4. Metal edge strips.

1.03 Submittals:

A. Submit samples of all tile and grout specified under this section for approval and color selection prior to installation.

B. Submit a "Master Grade Certificate" bearing signatures of both manufacturer and contractor.

C. Submit tile manufacturer's maintenance guides for owner's use in maintaining all tile work specified in this section.

D. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

F. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

G. Samples for Verification:
1. Full-size units of each type and composition of tile and for each color and finish required.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 24 inches square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory for each color and finish required.
4. Stone thresholds in 6-inch lengths.
5. Metal edge strips in 6-inch lengths.

H. Qualification Data: For qualified Installer.

I. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

J. Product Certificates: For each type of product, signed by product manufacturer.
1. Material Test Reports: For each tile-setting and - grouting product and special purpose tile.

1.04 Product Delivery, Storage and Handling:

A. Deliver all materials to job site in manufacturer's unopened containers with grade seal unbroken and labels intact. Keep containers dry. Comply with requirements in

ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

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

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.05 Project Conditions:

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.05 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.**

Part 2 - Products

2.01 General:

A. All tile shall be standard grades conforming to ANSI 137.1 unless noted otherwise.

B. Both glazed and unglazed ceramic tile shall be manufactured by the same manufacturer.

C. Refer to Color Schedule for tile color. Colors will a determining factor in tile approval.

D. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI AlOS.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

E. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

F. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do

not coat unexposed tile surfaces.

G. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Olean; Division of Dal-Tile International Inc.
   2. Crossville, Inc.
   3. Daltile; Division of Dal-Tile International Inc.

2.02 Ceramic Tile:

A. Wall Tile and Floor Tile:
   1. Type: wall tile – semi-polished porcelain / floor tile – matte porcelain.
   2. Nominal Face Size: 12” x 24” – orient as per Drawings.
   3. Edge: All-purpose cushion.
   4. Acceptable Manufacturer: American Olean – Ultra Modern.

B. Trim Shapes and Bases:
   1. Type: Same as floor tile.
   2. Includes bases, caps, stops, returns, trimmers and other shapes to finish installation.
      a. Base for Thin-Set Mortar Installations: Straight, module size 6 by 12 inches.
      b. External Corners for Portland Cement Mortar Installations: provide metal corner trim as manufactured by Schluter Systems LP unless otherwise indicated.
      c. External Corners for Thin-Set Mortar Installations: same as above.
      d. Internal Corners: Field-butted square corners. For base and cap use angle pieces designed to fit with stretcher shapes.

C. Setting Materials:
   1. Epoxy Mortar: ANSI A118.3
   2. Organic Adhesive: ANSI A136.1
   3. Latex Portland Cement Mortar: ANSI A118.4
   4. 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. Boiardi Products; a QEP company.
      b. Bonsai American; an Oldcastle company.
      c. Bostik, Inc.
      d. C-Cure.
      e. Custom Building Products.
      f. Jamo Inc.
      g. Laticrete International, Inc.

h. MAPEl Corporation.
i. Southern Grouts & Mortars, Inc.
j. Summitville Tiles, Inc.
k. TEC; a subsidiary of H. B. Fuller Company.

D. Grouting Materials:
1. Floor Tile: Epoxy Grout.
2. Wall Tile: Portland Cement Type.
3. 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. Boiardi Products; a QEP company.
b. BonsaI American; an Oldcastle company.
c. Bostik, Inc.
d. C-Cure.
e. Custom Building Products.
f. Jamo Inc.
g. Laticrete International, Inc.
h. MAPEl Corporation.
i. Southern Grouts & Mortars, Inc.
j. Summitville Tiles, Inc.
k. TEC; a subsidiary of H. B. Fuller Company.

E. Granite Thresholds:
1. Type: Polished granite.
2. Size: 1 1/4" wide x 1/2" high, double-beveled.
3. Location: Provide marble threshold at centerline of doors at transition between ceramic tile flooring and exposed concrete.

F. Accessories: Provide vitreous china accessories of type and size indicated, suitable for installing by same method as adjoining wall tile.
1. Color and Finish: Match adjoining glazed wall tile.

G. Elastomeric Sealants:
1. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."
a. Use sealants that have a VOC content of 250 gIL or less when calculated according to 40 CPR 59, Subpart D (EPA Method 24).
b. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.
2. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
3. One-Part, Mildew-Resistant Silicone Sealant: ASTM C

920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, 0; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1. DAP Inc.; 100 percent Silicone Kitchen and Bath Sealant.
   2. Dow Corning Corporation; Dow Corning 786.
   3. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
   4. Laticrete International, Inc.; Latasil Tile & Stone Sealant.
   5. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
   6. Tremco Incorporated; Tremsil 600 White.

H. Miscellaneous Materials:
   1. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
   2. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic base, designed specifically for required applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
      a. Equal to products manufactured by Schluter Systems LP.
      b. Provide in minimum lengths of 10’ where possible and practical.
      c. Provide at ALL exposed edges of ceramic wall tile – i.e. top, exterior corners, expansion joints, etc.
   3. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
      a. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil

with a melting point of 120 to 140 deg F per ASTM D 87.

b. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

4. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

5. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1. BonsaI American; an Oldcastle company; Grout Sealer.
2. Bostik, Inc.; CeramaSeal Grout & Tile Sealer.
3. C-Cure; Penetrating Sealer 978.
4. Custom Building Products; Grout Sealer.
5. Jamo Inc.; Penetrating Sealer.
6. MAPEl Corporation; KER 003, Silicone Spray Sealer for Cementitious Tile Grout and 004, Keraseal Penetrating Sealer for Unglazed Grout and Tile.
7. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
8. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.
9. TEC; a subsidiary of H. B. Fuller Company; TA-256 Penetrating Silicone Grout Sealer.

2.03 Porcelain Tile Panels:

A. Wall Tile Panels:

1. Type: Porcelain Tile Panel – Fokos 3+mm.
2. Nominal Face Size: 1000x3000mm – orient as per Drawings. **Where practical - all tile panels shall be factory cut prior to delivery to project site.**
3. Acceptable Manufacturer: Crossville, Inc.

B. Trim Shapes:

1. Includes shapes to finish installation.

a. Internal Corners: Field-butted square corners. For coved base and cap use angle pieces designed

to fit with stretcher shapes.

C. Setting Materials:
   1. As required by wall panel manufacturer.
   2. 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. Bostik, Inc.
      b. Custom Building Products.
      c. Laticrete International, Inc.
      d. MAPEl Corporation.
      e. TEC; a subsidiary of H. B. Fuller Company.

D. Grouting Materials:
   1. As required by wall panel manufacturer.
   2. 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. Bostik, Inc.
      b. Custom Building Products.
      c. Laticrete International, Inc.
      d. MAPEl Corporation.
      e. TEC; a subsidiary of H. B. Fuller Company.

E. Miscellaneous Materials:
   1. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic base, designed specifically for required applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
      a. Equal to products manufactured by Schluter Systems LP.
      b. Provide in minimum lengths of 10’ where possible and practical.
      c. Provide at ALL exposed edges of ceramic wall tile – i.e. top, exterior corners, expansion joints, etc.

Part 3 - Execution

3.01 Examination:

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
   1. Verify that substrates for setting tile are firm, dry, clean, and free of coatings that are incompatible with

tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI Al08.0 for installations indicated.

2. Verify that concrete substrates for tile floors installed with adhesives or thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
   a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
   b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
5. At Porcelain Wall Tile Panels: verify wall substrate has a maximum allowable variation of 1/8” in 10’ from required plane with no more than 1/16” variation in 24’. +

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

3.02 Preparation:

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tilesetting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI AlOS.IA and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.02 Installation:

A. All workmanship and materials shall conform in all respects to specifications and requirements and in accordance with the standard practice of the Tile Council of America.

B. All ceramic floor tile shall be installed using the following Tile Council of America specifications.
   1. Floor Tile, TCA F131-2K (Concrete).

C. Provide all required trim shapes required to module with field tile, unless otherwise noted on Drawings. All exterior corners shall have metal corner trim as manufactured by Schluter Systems LP.

D. Layout all tile work as to minimize cuts less than one-half tile in size. Align all joints to give straight uniform grout lines, plumb and level or parallel with walls. Strike all joints with a rounded, non-staining tool.
   1. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
   2. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
   3. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Layout tile work and center tile fields in both directions in each space or on each wall area. Layout tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
      a. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
      b. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
   4. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
      a. Wall Tile: 1/16 inch.
      b. Porcelain Wall Tile Panels: 1/16 inch.

5. Layout tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
6. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated or required by tile manufacturer. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   a. Where joints occur in substrates, locate joints in tile surfaces directly above them.
   b. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
   c. At Porcelain Wall Tile Panels: provide movement joint every 20’ to allow for needed movement of tile layer.
7. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
   a. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).
   b. Do not extend cleavage membrane waterproofing or crack isolation membrane under thresholds set in dry-set portland cement mortar. Fill joints between such thresholds and adjoining tile set on crack isolation membrane with elastomeric sealant.
      1. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
8. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

E. Slope entire room or area to floor drains.

3.03 Tile Backing Panel Installation:

A. Install cementitious backer units and treat joints according to ANSI AlOS.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless

otherwise directed in manufacturer's written instructions.

3.04 Waterproofing Installation:

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.05 Cleaning and Protecting:

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove epoxy and latex-portland cement grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

E. Immediately prior to final inspection, replace all damaged tile.

F. Contractor will supply 2% of the total quantity of each tile used. Contractor will supply 3% of the total quantity of each grout used. Place materials in clean marked containers for future use at building.

End of Section

DIVISION 9 - FINISHES

SECTION 09500 - ACOUSTICAL TREATMENT

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services, and incidentals necessary for the completion of this section of the work.

1.02 Related Work Specified Elsewhere:
- A. Ceiling Suspension Systems - Section 09120

1.03 Quality Assurance:
- A. Standards:
  - 1. American Society for Testing and Materials:
    - a. ASTM C-636 Recommended Practice of Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
    - b. ASTM E-84 Surface Burning Characteristics of Building Materials.
  - 2. Federal Specifications:
    - a. SS-S-118B, Sound Controlling Blocks and Boards. Underwriter's Laboratories, Inc.
- B. Submittals:
  - 1. Provide submittals in the form of samples, and documentation, to the Architect for review.

1.04 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers**

Part 2 - Products

2.01 Acoustical Ceiling Panels:
- A. 2x2 Tile - Tegular Edge:
  - 1. Type: FS-SS-S-118B, Class 25
  - 2. Size: 24" x 24" x 5/8". Provide special sizes as indicated on Drawings or as required by others.
  - 3. Finish: Board finish shall be a factory-applied white latex paint, medium textured non-direction fissured surface with a minimum light reflection of 80%.
  - 4. Noncombustibility: Board shall meet class 25-Federal Specification SS-S-118B, ASTM E-84; and, classified by Underwriter's Laboratories for Flame Spread Index 0-25.
  - 5. Type Example and Manufacturer:
    - a. Armstrong Fine Fissured No. 1732, beveled tegular 2x2).

Part 3 - Execution

3.01 Installation:

A. Install in specified grid system per ASTM C-636 and manufacturer's recommendations, as shown on the Drawings.

B. Provide ten (10) pieces of ceiling panels in cartons for future use. Panels shall be in perfect condition.

End of Section

DIVISION 9 - FINISHES

SECTION 09510 – ACOUSTICAL TREATMENT – BLADE PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions 1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes:

1. Acoustical ceiling panels / blades.

2. Exposed grid suspension system for ceiling panels / blades.

3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings.

B. Alternates:

1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been approved by Addenda, the specified products shall be provided without additional compensation.

2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers; Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.3 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 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

7. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

8. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

9. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Material

A. Armstrong Fire Guard Products

10. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint

11. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems

12. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum

13. ASTM E 1264 Classification for Acoustical Ceiling Products

B. International Building Code.

C. ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality.

D. NFPA 70 National Electrical Code.

E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures.

F. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components.

G. International Code Council-Evaluation Services Report - Seismic Engineer Report.

1. ESR 1308 - Armstrong Suspension Systems

1.4 SYSTEM DESCRIPTION

Canopies/Architectural Elements (Blades with suspension system).

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical blade 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 blades show locations of items that are to be coordinated with or supported by the ceilings.

D. Acoustical Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.

a. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.6 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 / Blades: 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.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling blade 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 blade 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.

SECTION 09510 – ACOUSTICAL TREATMENT – BLADE PANELS

1.8 PROJECT CONDITIONS

A. Space Enclosure:

Standard Blade Ceilings: Do not install interior blade ceilings until space is enclosed and weatherproof; wet work in place is completed and nominally dry; work above blade 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 blade ceilings shall be free of construction dust and debris.

1.9 ALTERNATE CONSTRUCTION WASTE DISPOSAL

A. Ceiling material being reclaimed must be kept dry and free from debris.

B. Contact the Armstrong Recycle Center - a consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant with provide assistance to facilitate the recycling of the ceiling.

1.10 WARRANTY

A. Acoustical Blade Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace blade panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Acoustical Blade 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.

1.11 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 Blade 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 Blade Panels:

1. Armstrong World Industries, Inc.

B. Suspension Systems:

1. Armstrong World Industries, Inc.

2.2.1 ACOUSTICAL CEILING UNITS

A. Acoustical Blade Panels

1. Surface Texture: Fine
2. Composition: Fiberglass
3. Color: White
4. Size: 10 in x 94 in
5. Edge Profile: Square for interface with 360 Painted Grid.
6. Noise Reduction Coefficient(NRC):
7. Ceiling Attenuation Class (CAC) :

8. Sabin:1.38

9. Articulation Class (AC):

10. Flame Spread: ASTM E 1264; Class A (UL)

11. Light Reflectance (LR) White Panel: ASTM E 1477; 0.9

12. Dimensional Stability: HumiGuard Plus

13. Recycle Content: Post-Consumer - 12% Pre-Consumer - 59%

14. Acceptable Product: SOUNDSCAPES Blades, 3921 as manufactured by Armstrong World Industries.

2.3.1 METAL SUSPENSION SYSTEMS

A. Components:

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: Charcoal Black.

c. Sustainability: Health Product Declaration (HPD)

d. Acceptable Product: 360 Painted Grid 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:

SECTION 09510 – ACOUSTICAL TREATMENT – BLADE PANELS

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.

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 blade 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.

C. Before disposing of ceilings, contact the Armstrong Recycling Center at 877-276-7876, select option #1 then #8 to review with a consultant the condition and location of building where the ceilings will be removed. The consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant with provide assistance to facilitate the recycle of the ceiling.

DIVISION 9 - FINISHES

SECTION 09650 – RESILIENT FLOORING

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services, and incidentals necessary for the completion of this section of the work.

1.02 Quality Assurance:
- A. Installation Qualification: contractors for floor covering installation shall be experienced in managing commercial flooring projects and provide professional installers, qualified to install the various flooring materials specified with a minimum of three years of documented experience. Installer shall be trained by flooring manufacturer and – if applicable – certified to install the specified flooring by the manufacturer.
- B. Manufacturer Qualifications: company specializing in manufacturing the specified flooring with minimum three years documented experience.

1.03 Submittals:
- A. Submit product data for each type of product indicated.
- B. Submit samples for color selection / verification.
- C. Maintenance Data and Instructions Furnish manufacturer's recommended maintenance methods and procedures.

1.04 Delivery, Storage, and Handling:
- A. Store resilient products and installation materials in dry spaces protected from the weather, at temperatures required by the product manufacturer. Store tiles on flat surfaces.

Part 2 - Products

2.01 General:
- A. Refer to color schedule – available tile colors WILL be a factor in product acceptance.

2.02 Materials:
- A. Resilient Floor Tile:
  Not applicable.
- B. Rubber Cove Base: ASTM F 1861, Type TP-Rubber as manufactured by Armstrong Cork Company or approved equal.
  1. Size: 4" high x .018 gauge.
  2. Provide preformed inside and outside corners.
- C. Edging Strips and Tile Reducers: size and length as required.
- D. Primer and Adhesive: As recommended by manufacturer of resilient floor tile for this particular project. All wall base and reducer strips shall be applied with epoxy adhesive.
- E. Cleaner or other finishing material: As recommended by

flooring manufacturer for the particular type of floor material.

Part 3 - Execution

3.01 Installation:

A. Comply with manufacturer's written instructions for installing specified wall base.

B. The Contractor shall be responsible for the manufacturer's representative making mat moisture and PH tests and reporting condition of concrete slab to the Architect in writing prior to placing floor materials.

C. Carefully examine the surfaces on which the above materials are to be applied, report to Architect in writing any unsatisfactory surface and do not begin work until all defective surfaces have been corrected. Otherwise, the Contractor shall assume responsibility for all failures and defects resulting from such defective surfaces.

D. Installation shall not begin until the work of all other trades, including painting, has been completed. The Contractor shall maintain all rooms and sub-floors at a minimum of 70 degrees F. for several days before and after application of tile.

E. The base shall be thoroughly cleaned and any pockets or cracks shall be filled in accordance with manufacturer's instructions flush with surface.

F. The material shall be applied in a first class, workmanlike manner by skilled mechanics experienced in this type of work.

G. Primer and adhesive shall be as recommended by the manufacturer of the flooring for this particular project. The adhesive for applying all materials shall be waterproof and shall be furnished and guaranteed by the flooring manufacturer.

H. Fit material neatly and tightly into breaks and recesses, around pipes and penetrations, under saddles or thresholds, and around permanent cabinets and equipment.

3.02 Cleaning and Waxing:

A. When, in the opinion of the Contractor, the flooring has sufficiently sealed itself to permit cleaning, the floors shall be thoroughly cleaned with a neutral cleaner as recommended by the manufacturer of the flooring used. After the floors have been cleaned, the Contractor shall protect the floors either with building paper or by keeping traffic off the floors until the building is ready for occupancy.

3.03 Replacement Base:

A. Provide enough spare wall base of matching color, in cartons to provide 20 linear feet of spare rubber wall base. Rubber wall base shall be in perfect condition.

End of Section

SECTION 09656 – TERRAZZO TILE

PART 1 General

1.01 Work Included:

A. Terrazzo tile and accessories.

B. Refer to the Drawings for bidding directions and color locations:

1. Tile (Gem) and Colors as per the following:

a. Gem Line / Expresso Macchiato – by floorazzo.

b. Gem Line / Pearl – by floorazzo.

c. Gem Line / Habanero – by floorazzo.

1.02 References (where applicable):

A. ASTM C 109/C 109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).

B. ASTM D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.

C. ASTM D 2047 - Standard Test Method for Static Coefficient of Polish-Coated Floor Surfaces as Measured by the James Machine.

D. ASTM D 2240 - Standard Test Method for Rubber Property--Durometer Hardness.

E. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

F. ASTM E 648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

G. ASTM E 662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

H. ASTM F 510 - Standard Test Method for Resistance to Abrasion of Resilient Floor Coverings Using an Abrader with a Grit Feed Method.

I. ASTM F 540 - Standard Test Method for Squareness of Resilient Floor Tile by Dial Gage Method.

J. ASTM F 925 - Standard Test Method for Resistance to Chemicals of Resilient Sheet Flooring.

K. ASTM F 970 - Standard Test Method for Static Load Limit.

L. ASTM F 1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

1.03 System Description:

A. Performance Requirements of Terrazzo Tiles:
   1. Abrasion Resistance: Maximum 0.0196 cubic centimeters volume loss, when tested in accordance with ASTM F 510, Taber abrader, S-39 wheels, at 500 cycles with 1,000 gram load.
   2. Compressive Strength: Between 2900 and 5000 psi (20 and 34.5 MPa), when tested in accordance with ASTM C 109/C 109M or ASTM D 695.
   3. Static Load Limit: 0.0007 inch maximum indentation, when tested in accordance with ASTM F 970 at 125 pounds.
   4. Hardness: When tested in accordance with ASTM D 2240:
      a. Matrix: Shore D 78, minimum.
      b. Aggregate: Between Barcol 55 and 100.
   5. Coefficient of Friction: Greater than 0.7, average 0.74, when tested in accordance with ASTM D 2047.
   6. Flame Spread Index: 15, maximum, when tested in accordance with ASTM E 84.
   7. Smoke Density: Specific optical density, when tested in accordance with ASTM E 662, of 231.76 (smoldering) and 292.05 (flaming).
   8. Critical Radiant Flux: Minimum of 0.93 watt/cubic centimeter (Class 1) when tested in accordance with ASTM E 648.
   9. Chemical Resistance: No change or surface attack, color change, or swelling, when tested in accordance with ASTM F 925.
   10. Oil Resistance: Complying with MIL D-3134.
   11. Corrosion Resistance: Complying with MIL D-3134.
   12. Electrical Conductance: Nonconductive.
   13. Squareness: 0.003 inch out of square, maximum, when measured in accordance with ASTM F 540.

SECTION 09656 – TERRAZZO TILE

1.05 Submittals:

A. Submit manufacturer's specifications and technical data for precast terrazzo tile and accessories; including manufacturer's printed installation instructions and maintenance manuals for each material specified.

B. Samples for Selection: Submit manufacturer's samples of actual sections of tile and accessories; include manufacturer's full range of color and patterns available.

C. Samples for Verification Prior to Installation: Submit full size samples of all types, colors, and patterns selected, indicating full range of patterning and color variations.

D. Test Reports: Submit test reports for bond and moisture tests of substrates.

E. Certificates: Submit certificates from manufacturer stating compliance with applicable requirements for materials specified.

1.06 Quality Assurance:

A. Installer Qualifications: A firm that has at least three years of experience with the installation of precast terrazzo tile and has successfully completed installations of a similar size and scope.

B. Regulatory Requirements: Comply with requirements of local building codes and applicable regulations of other government authorities.

C. Pre-Installation Meeting: Meet with tile manufacturer's representative and Owner prior to preparation of substrate and installation of tile, to review manufacturer's instructions and requirements to ensure the tile is installed properly.

1.07 Delivery, Storage, and Handling:

A. Deliver materials in original, unopened packages, containers or bundles bearing brand name and identification of manufacturer.

B. Store materials inside, under cover in a manner to keep them dry, protected from the weather, direct sunlight,

surface contamination, corrosion, and damage from construction traffic and other causes.

1.08 Project Conditions:

A. Maintain minimum temperature of 70 degrees F in spaces to receive terrazzo tile, for at least 48 hours before, during and after installation. Store materials in space where they will be installed for at least 48 hours or as required ensuring that the materials have reached 70 degrees F before staring installation.

B. Install terrazzo tile and accessories after other finishing operations, including painting, have been completed.

C. Do not install terrazzo tile on concrete slabs until they have been cured and are sufficiently dry to achieve bond with adhesives, as determined by the tile manufacturer's recommended bond and moisture test. Allow sufficient time for the slab to dry out before installation is started. **Contractor shall provide all additional materials required – i.e. leveling compounds, concrete sealers, specified adhesive necessary for conditions at the time of installation, etc. - to properly install flooring at no additional cost to the Owner.**

D. Provide adequate lighting to allow for proper installation.

E. Do not use portable or temporary heat.

1.09 Warranty:

A. Submit 20 year wear warranty written material warranty from tile manufacturer warranting that tile is free from defects in workmanship and material.

1. Products must be installed so as not to void the manufacturer's warranty for wear.

2. Warranty shall be in form acceptable to Owner.

1.10 Maintenance:

A. Extra Materials: Furnish one box of tile for each fifty boxes or fraction thereof, for each type, color, pattern and size of the tile installed, from same manufactured lot as materials installed.

1. Deliver extra tile to Owner after completion of work.

2. Furnish tiles in protective packaging with identifying labels.

Part 2 – Products

2.01 Manufacturers:

A. Acceptable Manufacturer: Floorazzo Tile by Floorazzo Tile, LLC, which is located at: 215 West Third Street, Siler City, North Carolina 27344; Tel: 919-663-1684.

B. Substitutions: as approved by Architect.

C. Obtain all materials including terrazzo tile and recommended adhesives and leveling compounds from a single manufacturer.

2.02 Materials:

A. Terrazzo Tile: Marble or granite chips embedded in flexible thermoset polyester resin matrix, with random distribution of chips and smooth factory applied urethane coating cured by ultra violet exposure process.

1. Color/Pattern: As indicated above and on Drawings.

2. Thickness: Marble CL-600/3, 3/16 inch thick.

3. Size: 24 by 48 inches, nominal.

4. Color Match: Obtain all tile materials from same production run.

B. Wall Base: Floorazzo straight wall base where indicated.

C. Leveling Compound for Large Areas: Self-leveling polymer modified pozzolanic formula; for use over concrete from a featheredge to 1-1/2 inches.

D. Patching Compound for Small Areas:

1. Fast Setting Underlayment for use over concrete from a featheredge to 1-1/2 inches.

2. Rapid Setting Underlayment for use over wood and concrete from a featheredge to 1-1/2 inches, for installations requiring flexural properties.

3. Skim Coating Patch, for use over wood and concrete

from a featheredge to 1/8 inch as a skim coat for minor depressions.

E. Floor Adhesive – as recommended by manufacturer:

1. Powdered Multipurpose Adhesive mixed with water, for installation using 1/8 by 1/8 by 1/8 inch U-notched trowel.

2. Pre-Mixed Wet Set Adhesive for installation using 3/32 by 3/32 by 3/32 U-notched trowel.

3. Pre-Mixed Wet Set Adhesive for installation using 3/32 by 3/32 by 3/32 U-notched trowel.

F. Sealer and Finish: Two coats of protective sealer and applied as recommended by manufacturer.

G. Sealant: Silicone, as specified in Section 07900, and of type approved by tile manufacturer.

Part 3 – Execution

3.01 Examination:

A. Concrete Subfloor:

1. Inspect subfloor to verify that it is clean, flat, smooth, level and free from cracks, holes, ridges, coatings preventing adhesion, and other defects impairing performance or appearance.

2. Notify Architect of conditions that would adversely affect flooring installation; do not proceed until defective conditions have been corrected.

3. Perform bond and moisture tests on concrete subfloors to determine if surfaces are sufficiently cured and dry as well as to ascertain presence of curing, sealing, hardening or any other compounds.

a. Perform bond test in accordance with tile manufacturer's warranty requirements.

b. Perform moisture test in accordance with ASTM F 1869.

c. Do not install tile if moisture vapor

transmission exceeds 7 pounds per 1000 square feet in 24 hours using FA88 Adhesive.

d. Submit test results and obtain Architect's acceptance prior to beginning installation.

4. Do not proceed until substrate preparation is complete and satisfactory, bond and moisture tests are completed and test reports submitted which indicate that bond and moisture values meet specified requirements.

B. Coordinate work with that of other installers prior to installation so that tile work fits properly with doors, frames, saddles, floor drains, and other adjacent work.

C. Start of work constitutes acceptance that conditions are satisfactory.

D. Close the space and areas where flooring is being installed to traffic and other installers until flooring has set and sealing and finish of tiles are complete.

3.02 Preparation:

A. Fill small cracks, holes and depressions in subfloors using leveling and patching compounds recommended by tile manufacturer.

B. Remove deleterious coatings from subfloor surfaces that would prevent a positive adhesive bond; such as curing compounds incompatible with adhesives, paints, oils, adhesives, waxes and sealers.

C. Completely remove existing solvent-based adhesives to prevent bleed through and staining.

3.03 Installation:

A. Comply with manufacturer's instructions for terrazzo tile installation.

B. Scribe, cut, and fit tile to permanent fixtures, built-in furniture, cabinets, pipes, outlets and permanent columns, wall, and partitions using tile cutting procedures recommended by tile manufacturer.

C. Maintain reference markers indicated on subfloor for future cutting, by repeating on finished terrazzo tile floor.

D. Lay tile 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 use of cut widths less than one half tile at perimeters. Lay tile square to room axis, unless otherwise indicated.

E. Adhere tile flooring to substrate using full spread of adhesive.

F. Lay tile using conventional procedures for laying resilient tile, placing tile carefully and firmly in position and as level as possible. Butt tile cleanly, evenly and snugly against adjacent tile.

G. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged, if cartons are so numbered. Do not install broken, cracked or chipped tiles.

H. Roll and cross roll floor with 150 pound sectional roller continuously while tile is being laid. Use hand roller in areas that cannot be reached with large roller. Cease rolling when rolling has no more effect.

I. Do not subject floors to traffic until adhesive is dry and hard and sealers and finishes are applied.

J. Remove and replace tiles that are not flat, including lipped, cupped, curved, or poorly adhered tile. Remove rejected tile from site.

3.04 Field Quality Control:

A. Manufacturer's Field Services: Provide on-site services of tile manufacturer or authorized distributor for technical assistance during preparation and installation.

3.05 Cleaning and Protection:

A. Upon the completion of installation and curing of adhesive, apply sealant to entire perimeter and around columns, door frames, and other joints and penetrations to prevent water penetration into the adhesive layer due to accidental or maintenance (mopping) water accumulation.

B. Remove excess adhesives, dirt, stain and other foreign material. Clean floors in accordance with tile manufacturer's instructions.

C. Protect finished installation at all times. Repair or replace flooring damaged prior to final acceptance of installation by Architect.

End of Section

SECTION 09681 – CARPET TILE

Part 1 - General

1.01 Work Included:

A. Work includes but is not limited to providing carpet tile and installation.

1.02 Quality Assurance:

A. Standards:

1. The carpet manufacturer shall have no less than fifteen years of production experience with modular carpet similar to type specified. Published product literature of carpet manufacturer must clearly indicate compliance of products with requirements of this section.

B. Installer Qualifications:

1. The installation provider must be directly responsible for the quality of the completed floor covering installation, including both the quality of the materials and labor used in the installation. The installation provider must directly warrant to owner that all products, materials and services related to the floor covering installation (including any floor covering(s), adhesive(s) and/or other products or materials used in the installation) will meet specifications set forth herein. The product warranty required herein must be provided directly by the carpet manufacturer.
2. The installation provider must have successful carpet installation experience similar to the work of this Section and be recommended, trained and approved by the carpet manufacturer.

1.03 Submittals:

A. Manufacturer’s Data - copies, as required, of carpet manufacturer’s specifications and installation instructions for carpet and related items specified.

B. Fiber Verification – Certification from the fiber producer verifying use of the premium branded, Post-Consumer Content Type 6 fiber in the submitted carpet product.

C. All applicable product warranties provided by manufacturer.

1.04 Delivery and Storage:

A. Deliver all materials to the installation site in the manufacturer’s original packaging. Packaging to contain manufacturers name, identification number and related information.

B. Product to be delivered as required by manufacturer. Store in pallet form as supplied by manufacturer. Do not stack pallets.

C. Store materials in area of installation for a minimum period of 48 hours prior to installation.

1.05 Installation Quality Assurance:

A. Flooring contractor to be specialty contractor normally engaged in this type of work and shall have three (3) years minimum documented experience in the installation of these materials.

B. Flooring contractor and sub-contractors must be approved by the architect and/or the carpet manufacturer.

C. Flooring contractor will be responsible for the proper product installation, including floor preparation in all the areas indicated in the drawings to receive carpet. The carpet installation standard will be as listed in The Carpet and Rug Institute's **Standard for Installation of Commercial Carpet CRI-104.**

D. Flooring contractor to provide owner a written warranty that guarantees the completed installation to be free from defects in materials and workmanship for a period of no less than one (1) year after job completion.

F. Qualifications of Installers: All work shall be done by installation firms specializing in commercial carpet installation. It is required, that the firm shall be a member of the Floor Covering Installation Contractor's Association (FCICA) and/or certified by the Floor Covering Installation Board (FCIB).

G. Floor temperatures must be a minimum of 65^0 for 24 hours prior to installation. Floor temperature can usually vary $5\text{-}10^0$ lower than room temperature. Modules must be conditioned to room temperature for 24 hours prior to installation. Relative humidity must be between 10%-65% maximum for 24 hours prior to installation. These conditions must also be maintained for 48 hours after completion of installation.

H. All carpet modules must be installed in the order they were manufactured. Select pallets in sequential order and follow the numbers located on each carton of tiles. Typically, an installation will begin with the lowest carton numbers and progress through the highest numbers until project is complete.

I. Full Spread Adhesive System: Requires a full spread adhesive system for the most trouble-free installation. Fully spread adhesive using a 1/32 x 1/16 x 1/16 "U" or "V" notch trowel. Allow to completely dry so adhesive does not transfer when touched. The proper amount of

adhesive is mandatory to prevent the modules from shifting or moving.

1.06 Job Conditions:

A. Sub-floor preparation is to include all required work to prepare the existing floor for installation of the product as specified in this document.

B. Carpet installation shall not commence until painting and finishing work is complete and ceiling and overhead work is tested, approved, and completed.

C. Site conditions shall include those specified in the carpet manufacturer's installation manual and shall also include sufficient heat, light, and power required for effective and efficient working conditions.

1.07 Extra Materials:

A. Provide five percent (5%) extra material for shelf stock of carpet for each color and type specified.

1.08 Warranty - Carpet:

A. Warranties must be the standard, printed warranties on the carpet manufacturer's letterhead. All warranty items to be full term, not pro-rated for the indicated period. All warranties must be issued by the manufacturer as standard published warranties on all types of carpet within this document. If the product fails to perform as warranted when properly installed and maintained according to procedures, the affected area will be repaired or replaced at the expense of the manufacturer. The carpet manufacturer, will provide standard published written performance warranties for the following:

1. **Lifetime against excessive surface wear.** Excessive wear means no more than 10% loss of pile fiber weight measured before and after use as tested under ASTM D-3936.
2. **Lifetime static protection**, meaning built-in protection below 3.0 kv as tested under AATCC-134.

B. Carpet manufacturer shall warrant carpet manufactured with secondary backing for the useful life of the original installation against product failure from:

1. Tuft Bind (edge ravel, yarn pulls, zippering)
2. Delamination
3. Moisture Penetration
4. Dimensional Stability

C. All warranties to be sole source responsibility of the carpet manufacturer. Second source warranties that involve parties other than the carpet manufacturer are unacceptable.

D. Warranties shall not be written only for this purchase or purchaser. All warranties shall be standard issue nationally of official documents.

1.09 Performance Insurance General:

A. Flammability Requirements:

1. Pill Test / DOC-FF-1-70 (ASTM D-2589)
   Requirement: Pass
2. Flooring Radiant Panel / ASTM E-648
   Requirement: Class 1 (Above .45 w/cm)
3. Optical Smoke Density Test / NFPA-258 NBS Smoke Chamber (ASTM E-662)
   Requirement: Less than 450, Flaming Mode
4. Comply with the Carpet and Rug Institute (CRI) VOC Chamber Test/Indoor Air Quality test (CRI-IAQ) Green Label Test

B. Face Fiber Characteristics for **all** Carpets

1. Bulked Continuous Filament (BCF),
2. Acceptable Fiber Systems: as manufactured by Aquafil.

C. Sustainable Carpet Assessment Standard:

1. NSF - 140 Gold.
2. Carpet manufacturer and/or fiber producer must be a signatory of the National Carpet Recycling Agreement memorandum of understanding.

1.10 Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.

Part 2 - Products

2.01 General:

A. Certified test reports shall be submitted by the carpet manufacturer, for all performance assurance specifications listed below.

B. Requirements listed below must be met by all products being submitted for approval.

C. All submitted test numbers should represent average for standard production goods.

2.02 Product Specification - Modular carpet tile shall meet the following specifications:

A. Style: InterfaceFLOR - Profile

B. Yarn: 100% Nylon (with 4% post-consumer content and +/- 60% total recycled content)

C. Dye Method: 100% Solution / Yarn Dyed

D. Surface Texture: Tufted Texture Loop

E. Gauge: 1/12
F. Yarn Weight: 18 oz./SY
G. Finished Pile Thickness: .116 inch (ASTM D-418)
H. Density: 5,586
I. Stitches Per Inch: 8.33
J. Secondary Backings: GlasBac Tile
K. Modular Size: 19.69” x 19.69"
L. Color: refer to Room Finish Schedule.
M. Special Treatments: ProTex® Fluorochemical

2.03 Minimum Construction Standards:

A. Nylon Specification - All nylon fiber shall be branded (premium) type 6 nylon from Aquafil with performance certification from the fiber manufacturer.

B. Antimicrobial, registered by the EPA for use in carpeting with broad spectrum efficacy against the growth of bacteria and fungi for a minimum of 15 years, assuming proper maintenance. The antimicrobial ingredient shall meet standards set by the U.S. General Services Administration (GSA) for Antimicrobial Carpet as supported by independent lab testing less than six months old.
   1. Intersept (AATCC 138 Washed).
   2. The preservative should be incorporated into the primary latex coating of the product during the manufacturing process, not topically applied to the carpet fibers.
   3. The antimicrobial treated carpet when new must pass GSA parameters for treated carpets via AATCC method 174 parts II and III. Initial performance must be 90% reduction of the microorganisms (Staphylococcus aureus 6538 and Klebsiella pneumoniae 4352) and no fungal growth on either the primary backing or fibers both on washed (AATCC method 174) and non-washed samples.
   4. The antimicrobial treated carpet must maintain, for the warranted life of the carpet, a minimum of 90% reduction of the microorganisms (Staphylococcus aureus 6538 and Klebsiella pneumoniae 4352) listed in AATCC method 171 part II, provided the carpet is maintained as specified. Additionally, the antimicrobial treated carpet must maintain a "no macroscopic growth" rating against Aspergillus niger 6275 at the primary backing in accordance with AATCC 171 part III.
   5. The preservative must be environmentally responsible i.e. (biodegradable and not toxic to non-target species).

6. Efficacy of the preservative should be documented in professional peer reviewed scientific publications.

2.04 Related Carpet Materials:

A. Leveling compound - Latex type as recommended by carpet manufacturer. Must be compatible with carpet adhesive and curing/sealing compound on concrete.

B. Releasable pressure sensitive type adhesive – Adhesive must be water-based and allow for removal of carpet tile at any time without damage to carpet or substrate. Adhesive must contain antimicrobial preservative and have "zero" calculated VOC's.

C. Carpet edge guard, non-metallic - Extruded or molded heavy duty vinyl or rubber carpet edge guard of size and profile indicated, and with minimum two inch wide anchorage flange; colors selected by architect/designer from among standard colors available within the industry.

D. Miscellaneous materials - As recommended by manufacturer of carpet. Other carpeting products to be selected by installation provider to meet project requirements.

E. Electrostatic (Dissipation low-generation):
   1. < 3.0 KV (AATCC 16-E).

F. Lightfastness:
   1. $\geq$ 4.0 @ 60 AFU's.

Part 3 - Execution

3.01 Installation:

A. General
   1. Comply with manufacturer's instructions and recommendations for uniformity of direction.
   2. Install carpet under open-bottom obstructions and under removable flanges and furnishings, and into alcoves and closets of each space.
   3. Provide cut outs where required. Conceal cut edges with protective edge guards or overlapping flanges.
   4. Run carpet under open bottom items such as heating convectors and install tight against walls, columns and cabinets so that the entire floor area is covered with carpet. Cover over all floor type door closures.
   5. Install edging guard at all openings and doors wherever carpet terminates, unless indicated otherwise.
   6. Cutting shall be done in accordance with the manufacturer's recommendation, using the tools designed for the carpet being installed.

7. Use leveling compound where necessary. Any floor filling or leveling shall have a minimum of 4’0” of feather.
8. Expansion joints - Do not bridge building expansion joints with continuous carpeting.

B. Installation
1. Install carpet according to carpet manufacturer’s printed instructions and in accordance with the Carpet and Rug Institute’s Installation Standard.

3.03 Cleaning and Protection:

A. On completion of the installation in each area, all dirt, carpet scraps, etc. must be removed from the surface of the carpet.

B. Remove debris, and sort pieces to be saved from scraps to be redirected and recycled.

C. Construction manager shall protect carpeting against damage during construction.

3.04 Inspection:

A. Upon completion of the installation, verify that work is complete, properly installed and acceptable.

End of Section

DIVISION 9 - FINISHES

SECTION 09770 – SPECIAL WALL SURFACES

PART 1 GENERAL

1.1 SECTION INCLUDES

1. Pre-manufactured panel system including mounting hardware and specified accessories.

1.2 RELATED SECTIONS

1. Section 06100 - Rough Carpentry; furring, blocking, and other carpentry work that is not exposed to view.

2. Section 06200 – Finish Millwork; for interior woodwork other than wall systems not included in this section.

3. Section 09250 - Gypsum Wallboard Assemblies; for metal support systems not included in this section.

1.3 REFERENCES

1. American Society for Testing and Materials (ASTM) E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   a) Class 1/A - Flame Spread 0-25, Smoke Developed 450 or less.
   b) Class 2/B - Flame Spread 26-75, Smoke Developed 450 or less.

2. Architectural Woodwork Institute (AWI) Quality Standards.

3. National Electrical Manufacturer’s Association (NEMA)

1.4 SUBMITTALS

1. Submit under provisions of Special Conditions.

2. Product Data: Manufacturer's Safety Data Sheets (MSDS) on each product to be used, including:
   a) Preparation instructions and recommendations.
   b) Storage and handling requirements and recommendations.
   c) Installation methods.

3. Shop Drawings: Shop drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with adjacent work.

4. Selection Samples: For each finish product specified, one complete set of color samples representing manufacturer's standard range of available colors and

patterns.

1.5 QUALITY ASSURANCE

1. Manufacturer Qualifications:
   a) Firm experienced in successful production of wall systems similar to that indicated for the Project, with sufficient production capacity to produce required units without causing delay in the work.
   b) Provide certificate signed by panel manufacturer certifying that products comply with specified requirements.

2. Installer Qualifications: Demonstrate successful experience in installing architectural woodwork similar in type and quality to those required for this project.

1.6 DELIVERY, STORAGE, AND HANDLING

1. Do not deliver wall system until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate wall system have been completed in installation areas as specified by AWI 1700-G-3.

2. If panels are stored prior to installation, store them flat in completely enclosed areas, out of the weather. If panels must be stored in other than installation areas, store only in areas where environmental conditions comply with manufacturers recommendations. Do not expose panels to continuous direct sunlight, nor to extremes in temperature and humidity. Store products in manufacturer's packaging until ready for installation.

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

1.7 PROJECT CONDITIONS

1. Do not deliver or install wall system until building is enclosed, wet work is complete and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period as specified by AWI 1700-G-3.

2. Do not install wall system until normal lighting conditions exist. Normal lighting conditions are described as those in place when the project is finished. This includes, but not limited to, design

lighting (wall washers, spotlights and flood lights, and similar fixtures) and natural lighting.

3. Wall, ceilings, floors, and openings must be level, plumb, straight, in-line and square as specified by AWI 1700-G-3.

~~4.~~ Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results, both during installation and subsequent occupancy. Do not install products under environmental conditions outside manufacturer's absolute limits. Panels shall be conditioned in the environment in which they will be installed for a minimum of 72 hours prior to installation. The recommended environment is 60^0 to 80^0 F and 35% to 55% relative humidity.

5. Manufacturer warrants any product it has manufactured and sold against defects in materials or workmanship for a period of one year from the date of original purchase and acceptance for use. This warranty extends to products assembled / installed and used in the manner intended and does not cover damage or failure caused by misuse, abuse or accidents, exposure to extreme temperature, improper installation, improper maintenance and exposure to water or excessive humidity or excessive moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

1. Acceptable Manufacturer: Panel Specialists, Inc.; 3115 Range Rd., Temple, TX 76504. ASD. Toll Free Tel: (800) 947-9422. Tel: (254) 774-9800. Fax: (254) 598-3222. Email: psiwalls@panelspec.com. Web: http://www.panelspec.com.

2. Substitutions: Requests for substitutions will be considered in accordance with provisions of Special Conditions.

2.2 PANEL SYSTEMS

1. Provide prefinished decorative panels where shown on the drawings, as specified herein, and as needed for a complete and proper installation.

2. Comply with applicable requirements of "Architectural

Woodwork Quality Standards" in the production and installation of the wall panel system as published by the Architectural Woodwork Institute (AWl) unless otherwise indicated.

3. Panel System: #312 /310 as manufactured by Panel Specialists, Inc. A progressive panel system with an exposed ½ in. (12mm) recessed horizontal channel reveal and a 1/16 in. (1.5mm) vertical reveal between edge banded panels. The horizontal reveal can be accented with a concave insert or p-lam or veneer strips. Recommended for vertical and horizontal interior installations. Maximum panel length for horizontal installations is 96 inches (2438 mm).
   a) Panel Thickness: 7/16 inches (11.1 mm).
   b) Horizontal Reveal: System to provide a ½" (12mm) wide recessed reveal between panels.
   c) Vertical Reveal: System to provide a 1/16" reveal between panels.
   d) Panel Edge Finish: Panel edges to be finished with .018-inch (.5mm) PVC edge banding or wood veneer, except as noted in material specifications.
   e) Panel Finish: Refer to Room Finish Schedule and drawings.
   f) Main Laminated Panel Fire Rating:
      a) Fire Rating: ASTM E84, Class A.
   g) Molding: All moldings to be .062" thick (at structural areas) 6063 alloy aluminum with T5 temper.
      a) Divider Moldings
         1. #312 ½" wide Horizontal Recessed Channel Divider Molding
         2. #302a 1/16" wide Vertical Divider Molding.
      b) ½" Wide Edge Trims & 1" Corners (where applicable)
         1. #304 ½" Edge Trim Molding
         2. #304A ½" Edge Trim Molding (2-piece)
         3. #103-90 1" Rounded 90° Outside Corner
         4. #103-135 135 ° Outside Corner
         5. #304-90 End Cap for top and bottom of 90° outside corner
         6. #304-135 End Cap for top and bottom of 135° outside corner
   h) Finishes:
      a) Panel Face:
         1. Finish #1: Flat Cut Red Oak
      b) Panel Face Pattern Direction:
         1. Vertical

c) Panel Edge Banding:
1. Finished wood veneer (for wood veneer surfaced panels)

2.3 MATERIALS

1. Wood Veneer Panels.
   a) Veneers from standard range of veneer species will be HPVA Architectural Grade A or better.
   b) Veneer leaves to be balanced matched on the panel
   c) Panels to be finished on the edge with matching veneer edge banding
   d) Finish to be durable UV coating with a gloss (50%) or satin (20%) finish.
   e) Finish to be clear.
   f) Panels to be vertically sequenced matched on the wall.

PART 3 EXECUTION

3.1 EXAMINATION

1. Do not begin installation until substrates have been properly prepared according to AWI 1700-G-3.

2. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 FIELD DIMENSIONS

1. Where wall system is indicated to be fitted to other constructions, check actual dimensions of other constructions by accurate field measurements before manufacturing wall system; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of work.

2. Where field measurements cannot be made without delaying the work, guarantee dimensions and proceed with manufacture of wall system without field measurements coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

3.3 PREPARATION

1. Panels must be acclimated to ambient temperature and humidity conditions in accordance with manufacturer’s specifications prior to installation. Refer to PSI installation guide for proper, handling, storage, and

acclimation procedures.

2. Clean surfaces thoroughly prior to installation.

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

3.4 INSTALLATION

1. Install in accordance with manufacturer's instructions.

2. When interior paneling is on an exterior wall or in a wet area, provide a barrier sheet of plastic film between the outside wall and the panels in order to prevent condensation affecting the stability of the panels.

3. Field cutting of all wall systems should be accomplished using carbide tools. All face penetrations and cutouts should have a minimal 1/8-inch (3 mm) radius in corners according to NEMA Standards Publication LD 3-2005.

4. All wall systems should receive an "S" bead of panel mastic on the back of the panel during installation.

5. For vertical applications, wall systems shall be mechanically fastened to horizontal metal furring strapping spaced 24 inches (610 mm) O.C. Furring straps shall be no less than 18-ga 3-1/2 inches (89 mm) wide, continuously. Metal strapping to be installed to the drywall studs prior to the application of the gypsum board by the framing contractor. For panels installed with a horizontal orientation, strapping is recommended but not necessary

3.5 PROTECTION

1. Protect installed products until completion of project.

2. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

DIVISION 9 - FINISHES

SECTION 09900 - PAINTING

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this entire section of the work.
- B. Consult Drawings, finish schedules, details and specification section.

1.02 Quality Assurance:
- A. All painted surfaces shall be uniform in color, texture and finish to the satisfaction of the Architect.

1.03 Submittals:
- A. Submit manufacturer's specifications, including paint label analysis and application instructions for each material specified.
- B. Submit color samples for review of color and texture.
- C. Provide samples of all natural and stained wood finishes.
- D. Final samples: Prepare samples of finishes on the job to the satisfaction of the Architect. If required, a 4' x 8' portion of wall surface finished as final sample.

1.04 Product Deliver, Storage and Handling:
- A. Materials shall be delivered to the project site in strong, undamaged, waterproof containers with manufacturer's label intact. Materials in previously opened or unsealed containers, are not acceptable.
- B. Include on label of container: Manufacturer's name, type of paint, number and application instructions.
- C. Immediately upon delivery to the project site, all painter materials shall be stored and locked in a watertight shed with floor well off the ground. The shed shall remain locked at all times except for adding or removing materials.
- D. No materials of any manufacturer will be allowed on the project site any time during construction except those of the manufacturers specified or approved by the Architect.

1.05 Job Conditions:
- A. Comply with manufacturer's recommendations as to environmental conditions under which coating and coating systems can be applied.
- B. Do not apply finishes in areas where dust is being generated or where work in progress may affect finish quality.
- C. Protect finished work of other trades, and all surfaces not being painted concurrently, or not to be painted.

Part 2 - Products

2.01 General:
- A. The following specifications for Finishes is not intended to mention every particular item which will receive painter finish, but is intended to establish type and quality of finish which shall be required on various materials.
- B. **Products of Sherwin-Williams are specified herein to simplify descriptions of types and qualities of finishes required only.**

SECTION 09900 - PAINTING

Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.

C. Wherever the abbreviation "SW" appears in the following detailed specification, it shall be understood to mean Sherwin-Williams.

D. Primers shall be as specified by manufacturers of finish paint used and as approved by the Architect.

2.02 Acceptable Manufacturers:

A. Sherwin-Williams.

B. PPG Industries.

C. Cook Paint and Varnish Co.

D. Pratt and Lambert.

E Kelly-Moore.

2.02 Exterior Finishes:

A. Enamel on Ferrous Metals:
   1. One coat SW Kem Kromik Primer, (Alkyd primer).
   2. Two coats SW Industrial Enamel, (Alkyd gloss enamel).

B. Enamel on Exterior Door Frames and Doors:
   1. Shop coat by others-touch up as required.
   2. Two coats SW Industrial Enamel, (Alkyd gloss enamel).

C. Enamel on Galvanized Metal:
   1. One Coat SW Galvite primer.
   2. 2 Coats SW Industrial Enamel, (Alkyd gloss enamel).

D. Enamel on Exterior Concrete Block:
   1. One coat SW Promar Latex Block Filler B25W25.
   2. Two coats SW A-100 Semi-Gloss Latex Enamel.

2.03 Interior Finishes:

A. Enamel on Metal: All miscellaneous and ornamental metal items which are left exposed, hollow metal doors and frames.
   1. Shop coat by others - touch up as required.
   2. Two coats SW Promar 200 Semi-Gloss. Enamel, (Alkyd semi-gloss enamel).

B. Enamel on Concrete Block:
   1. One coat SW Promar 200 Block Filler (vinyl acrylic latex).
   2. Two coats SW Promar 200 Semi-Gloss Enamel.

C. Enamel on Gypsum Board Ceilings/Facias/Walls
   1. One coat SW Promar 200 Wall Primer with Medium Texture. (Vinyl Acrylic Latex Wall Primer.)
   2. Two coats SW Promar 200 Semi-Gloss Latex Enamel.

D. Tape and Float: Joints on Gypsum Board.
   1. As per manufacturer's instructions.
   2. All joints shall be sanded ready for primer's finish.

E. Interior Millwork and Cabinetry:
   1. One coat SW Promar 200 Alkyd Enamel Primer/Undercoat.
   2. Two coats SW Promar 200 Semi-Gloss Latex Enamel.

F. Enamel on Wood Trim:
   1. One coat SW Promar 200 Alkyd Enamel Primer/Undercoat.
   2. Two coats SW Promar 200 Semi-Gloss Latex Enamel.

G. Back-Painting, Interior Work:
   1. Two coats SW Promar 200 Alkyd Enamel Primer/Undercoat.

H. Enamel on Exposed Metal Piping:
   1. One coat SW Galvite primer.
   2. Two coats SW Promar 200 Semi-Gloss Latex Enamel.

Part 3 - Execution

3.01 Inspection:
   A. Notify Contractor of any surface not in proper condition to be finished before proceeding with the work. Starting work will constitute the painter's acceptance of preceding work, and conditions under which finish will be applied and his assumption of responsibility for results to be obtained.

3.02 Preparation of Surfaces:
   A. Wood:
      1. Sand to a smooth even surface, then dust off.
      2. Touch-up knots, resinous spots, etc., on all surfaces with shellac 18 hours before applying prime coat.
      3. Fill nail holes, cracks and blemishes flush after priming coat has dried.
   B. Concrete Block and Concrete:
      1. Repair cracks and irregularities to provide uniform surface texture.
   C. Ferrous Metal Surfaces:
      1. Remove rust and scale, clean grease or oil surfaces with turpentine or benzine before painting.

3.03 Application:
   A. Number of coats and quality of finish shall be in accordance with these specifications, which requires the use of material which will product first quality finish if properly applied.
   B. Apply coats of material in strict accordance with manufacturer's currently published specifications, except where requirements of these specifications are in excess or manufacturer's requirements.
   C. Except as otherwise approved by the Architect, the first two coats of painter's finish shall be applied by roller or brush application. Finish coats may be applied by spray application.
   D. Comply with recommendation of product manufacturer for drying time between succeeding coats allow additional as required until finish is dry.
   E. All work where a coat of material has been applied must be inspected and approved before application of succeeding coat, otherwise, no credit for the coat well be given. Notify Architect when a particular coat has been completed for inspection and approval.
   F. Shellacs, oils, turpentine, etc., shall be of the highest quality and subject to approval of Architect. Materials shall be mixed in and applied directly from containers which they are purchased except when use of other containers is approved.
   G. First Coat of all finishes, except of varnish and stains, shall be white.

H. Sand lightly between coats where shellac, varnish or enamel is used.

I. Remove all hardware, accessories, machined surfaces, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations.

3.04 Clean-up:

A. Clean and paint spots from work and touch-up or otherwise repair any defective or damaged work.

B. Remove all surplus materials and equipment after work is completed.

C. Leave entire job clean and acceptable to the Architect.

End of Section

DIVISION 10 - SPECIALTIES

SECTION 10100 - MARKERBOARDS AND TACKBOARDS

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this section of the work.

1.02 Quality Assurance:
- A. Standards:
  - 1. American Society for Testing and Materials:
    - a. ASTM A-424, Steel Sheets for Porcelain Enameling.
  - 2. Federal Specifications:
    - a. LL-B-810B, Hardboard.
  - 3. Military Specifications:
    - a. MIL-C-15116C, Cork Sheet.

1.03 Submittals:
- A. Shop Drawings: Submit dimensioned ship Drawings indicating location, type, size, arrangement, adhesive, backing, anchor or mounting details, trim, and accessories.
- B. Submit samples showing the full range of colors available for each unit.

Part 2 - Products

2.01 Materials:
- A. Porcelain Enamel Steel Markerboards:
  - 1. Type: Factory-built aluminum framed unit.
  - 2. Construction: Factory LCS face on 24 gauge steel laminated to 3/8" hardboard with .015 aluminum back-up.
  - 3. Color: LCS faces shall be white.
  - 4. Trim: Provide "H" bar joint cover at adjacent panels, color to match narrow leg showing, map rail with cork inserts and chalk trough.
  - 5. Accessories: Provide two map hooks with paper clips at each chalkboard unit.
  - 6. Mounting System: Concealed metal spline system. **At exterior walls provide "stand-off" mounting brackets to prevent condensation behind boards.**
- B. Tackboard:
  - 1. Type: Factory-built aluminum framed unit.
  - 2. Construction: Vinyl covered surface bonded to a 2" thick insulation board core, with a 7/8" x 5/8" aluminum frame. Refer to Color Schedule.
  - 3. Mount System: Manufacturer=s standard.
  - 4. Acceptable manufacturer: Best-Rite Vin-Tak tackboards.

SECTION 10100 - MARKERBOARDS AND TACKBOARDS

Part 3 - Execution

3.01 Installation:

A. Install units straight, plumb, and level with metal splice system. Refer to Drawings.

End of Section

DIVISION 10 - SPECIALTIES

SECTION 10400 - INTERIOR SIGNAGE

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this entire section of the work.

1.02 Quality Assurance:
- A. Standards:
  1. UFAS Fed. Std. 795-Requirements for the physically handicapped.
  2. MIL Spec. L-P-387a, type NDP, rated self-extinguishing, for sign materials.

1.03 Submittals:
- A. Provide manufacturer's catalog cut and data sheets, complete parts list and installation requirements for each item specified.
- B. Schedules: Indicate location and placement for all graphic items.

1.04 Product Delivery, Storage and Handling:
- A. Handle and store all items with care to prevent damage and injury to finish surfaces.

Part 2 - Products

2.01 Products of the manufacturers listed below have been specified herein to simplify descriptions of design, construction, and materials only. All items have been selected for visual and performance design quality which shall serve as a basis for acceptance of equivalent products by other manufacturers.

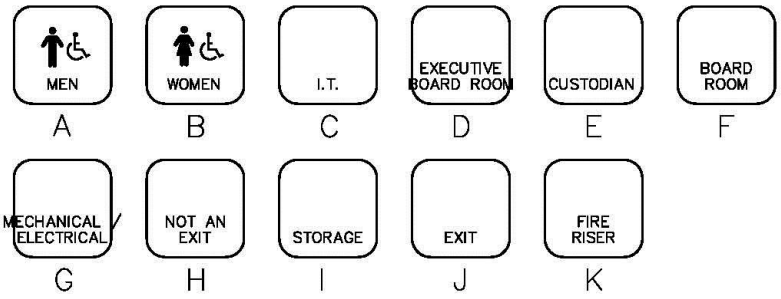
2.02 Signage System:
- A. Material: 1/8 inch thick, type ES melamine plastic.
- B. Size: 8" x 8" x 1/8", with 1/2" radius corners. Custom design - refer to 2.04 for text and symbols.
- C. Mounting: All graphics shall be permanently mounted to wall or door surface with tamper resistant screws.
- D. Color: refer to Color Schedule, submit color samples with submittals, prior to approval. **Colors will be a factor in product acceptance.**
- E. Letter Style: Helvetica Medium.
- F. Standard Grade 2 braille shall be below all copy, all signs.
- G. All graphic material shall meet the requirements of UFAS Fed. Std. 795, and MIL spec L-P-387a.
- H. Acceptable Manufacturer: Series 200A, Type D format, Mohawk Sign systems.

SECTION 10400 - INTERIOR SIGNAGE

2.03 Plaque Groupings Required (letter designation refers to 2.04):

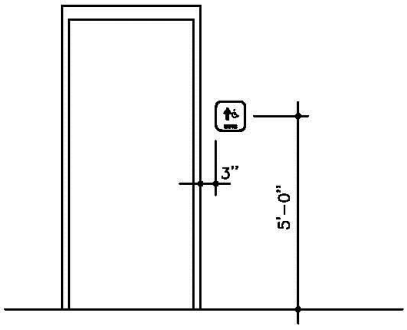
Plaque	**Quantity (total)**	**Location (1 sign per location)**
A	1	@ doors no. 7 & 19
B	1	@ doors no. 6 & 20
C	1	@ door no. 10
D	1	@ door no. 21
E	1	@ door no. 17
F	1	@ door no. 8
G	2	@ doors no. 9, 17 & 18
H	5	@ doors no. 13, 15, & 22
I	1	@ doors no. 11 & 16
J	6	@ doors no. 8, 12, 14, & 23
K	1	@ door no. 11

2.04 Signage Plaques Required:



Note: all signage plaques shall have grade 2 braille translations under text.

2.05 Typical Mounting:



Mounting Height

Typical Wall Location

Verify location with architect.

SECTION 10400 - INTERIOR SIGNAGE

Part 3 - Execution

3.01 Installation:

A. Comply with manufacturer's installation instructions and details on the Drawings. Set all units plumb and level in location indicated on the Drawings or as directed.

B. Provide all necessary accessories: Items to support or attach Identifying Devices to result in a complete installation.

C. Protect all signage plaques to prevent damage after installation.

End of Section

DIVISION 10 - SPECIALTIES

SECTION 10420 - LETTERS AND PLAQUES

Part 1 General

1.01 Work Included:
A. All materials, labor, services, and incidentals necessary for the completion of this entire section of the work.

1.02 Submittals:
A. Shop Drawings: Indicate details and dimensions of fabrication and installation including layouts and assemblies. Begin fabrication only after receiving approved shop Drawings.
B. Manufacturer's Literature: Descriptive literature and installation instructions.

1.03 Product Delivery, Storage, and Handling:
A. Handle and store all items with care to prevent damage and injury to finish surfaces.

Part 2 - Products

2.01 Cast Letters at exterior / interior locations:
A. Finish / Color: **CLEAR ANODIZED ALUMINUM.**
B. Letter Style: **OPTIMA FONT.**
C. Size: height – see below.
D. Mounting: coordinate with Architect.
E. Quantity: Sufficient letters to spell out the following (quantities in parentheses):

Exterior Locations -
1. Provide letters to spell out **DR. ROBERT A. ROMINES** (X 2 / 6” TALL / WALL MOUNTED)
2. Provide letters to spell out **BOARD OF EDUCATION CENTER** (X 2 / 6” TALL / WALL MOUNTED)
3. Provide cast Moore Public Schools’ logo, refer to drawings (x 2 / WALL MOUNTED). Coordinate with Architect.

Interior Locations –
1. **BOARDROOM** (X 1 / 12” TALL / WALL MOUNTED)
2. **MEN** (X 1 / 4” TALL / WALL MOUNTED)
3. **WOMEN** (X 1 / 4” TALL / WALL MOUNTED)

F. Verify exact spelling/punctuation with Architect.
G. Location: refer to the Drawings.
H. Acceptable Manufacturer: A.R.K. Ramos, Oklahoma City.

2.01 Cast Metal Plaque at interior location:

A. Castings shall be free from pits, scale, sand holes, or other defects. Comply with requirements specified for metal, border style, background texture, and finish, and with requirements

shown for thickness, size, shape, and copy. Hand-tool and buff borders and raised copy to produce the manufacturer's standard satin polished finish. Coordinate final design with Architect.

1. Metal: aluminum.
2. Border Style: Type 504.
3. Background Texture: manufacturer's standard No. 2 black pebble texture.
4. Letter Style: Helvetica upper case – raised satin aluminum finish.
5. Mounting Method: No. 4 concealed fasteners.
6. Finish: manufacturer's satin aluminum finish.
7. Size: 20 inches wide x 24 inches high.
8. Content:

NEW BOARD OF EDUCATION CENTER
MOORE PUBLIC SCHOOLS

SUPERINTENDENT OF SCHOOLS:
DR. ROBERT ROMINES

BOARD OF EDUCATION:

STACI PRUETT	PRESIDENT
MATT PURSER	VICE PRESIDENT
ERIN MORRISON	MEMBER
MANDY KINCANNON	MEMBER
JENNY NGUYEN-STATLER	MEMBER

BOND CONSULTANT:
JEFF HORN

ARCHITECT:
AGP – THE ABLA GRIFFIN PARTNERSHIP LLC
MOORE, OKLAHOMA

CONTRACTOR:
OMNI CONSTRUCTION LLC
MOORE, OKLAHOMA

9. Type Example: ARK-Ramos Manufacturing Company, Inc.

SECTION 10420 - LETTERS AND PLAQUES

Part 3 - Execution

3.01 Installation:

A. Install units plumb and level in locations indicated on the Drawings, following manufacturer's recommendations.

B. Provide all necessary accessories: Items to support or attach metal letters to result in a complete installation.

C. Protect all finishes to prevent damage before, during and after installation.

End of Section

DIVISION 10 - SPECIALTIES

SECTION 10520 - FIRE PROTECTION SPECIALTIES

Part 1 General

1.01 Work Included:
- A. All materials, labor, services and incidentals necessary for the completion of this entire section of the work.

1.02 Submittals:
- A. Submit Manufacturer's Literature: Descriptive literature, product data and installation instructions.

1.03 Product Delivery, Storage and Handling:
- A. Handle and store all items with care to prevent damage to equipment. Damaged equipment shall be rejected.

1.04 Quality Assurance:
- A. Standards:
  1. Conform to NFPA 10 requirements for portable fire extinguishers.
- B. Provide fire extinguishers, cabinets and accessories by a single manufacturer.

1.05 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.**

Part 2 - Products

2.01 Materials:
- A. Fire Extinguishers:
  1. Model No. 10E - Cosmic multi-purpose dry chemical fire extinguisher. UL, 4A-60-BC.
- B. Fire Extinguisher Cabinets:
  1. Model No.: Academy 1026V10 with return trim as required with rolled edge.
  2. Door Style: Contemporary V, with flat trim.
  3. Glazing: 1/4" clear acrylic.
  4. Finish: Aluminum, mill finish, clear anodized.
  5. Fire Rated Enclosure: provide fire stopping material to protect integrity of fire rated partition as required by applicable codes and standards.

Part 3 - Execution

3.01 Installation:
- A. Install equipment as located on the Drawings and comply with manufacturer's written instructions for equipment provided.
- B. Prepare recesses in walls for fire extinguisher cabinets as required for type and size of cabinet and style of trim, and

to comply with manufacturer's instructions.

C. Securely fasten mounting brackets and fire extinguisher cabinets to the structure, square and plumb, to comply with manufacturer's instructions.

D. Check extinguishers for proper charge operation.

E. Remove and replace damaged, defective or under charged units.

End of Section

DIVISION 10 - SPECIALTIES

SECTION 10800 - TOILET AND BATH ACCESSORIES

Part 1 - General

1.01 Work Included:
- A. All materials, labor, services, and incidentals necessary for the completion of this section of the work.

1.02 Submittals:
- A. Provide manufacturer's catalog cut and data sheets, complete parts list and installation requirements for each accessory item specified.
- B. Where applicable, submit maintenance data, operating instructions and keys required for each type of equipment and lock.

1.03 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.**

Part 2 - Products

2.01 The following model numbers refer to products of Bradley Corporation (except where noted otherwise).

2.02 Accessories:
- A. Grab Bars:
  1. Model No. 8120-001360-36".
  2. Quantity: 1 @ rooms 3, 4, 13, and 14
- B. Grab Bars:
  1. Model No. 8120-001420-42".
  2. Quantity: 1 @ rooms 3, 4, 13, and 14
- C. Grab Bars:
  1. Model No. 8120-001420-12".
  2. Quantity: 1 @ rooms 3, 4, 13, and 14
- D. Tilted Stainless Steel Mirror (Frame and Surface):
  1. Model No. 740-1830.
  2. Quantity: 1 @ rooms 3, 4, 13, and 14 (above washfountains / lavatories)
- E. Custodian's Utility Shelf/With Mop & Broom Holder:
  1. Model No. 9984, 36" long.
  2. Quantity: 1 @ room 12
- F. Toilet Paper Dispenser to be provided by Owner and installed by Contractor. 1 @ rooms 4, 13, and 14 / 2 @ room 3
- G. Paper Towel Dispenser to be provided by Owner and installed by Contractor. 1 @ rooms 1 @ rooms 3, 4, 13, and 14
- H. Soap Dispenser to be provided by Owner and installed by Contractor. 1 @ rooms 3, 4, 13, and 14

SECTION 10800 - TOILET AND BATH ACCESSORIES

Part 3 - Execution

3.01 General:

A. Install where noted on the Drawings and mount as indicated or per manufacturer's recommendations.

B. Use concealed or tamper-proof fasteners of same material and finish as unit. Provide anchors, bolts, and other mounting devices and attach units securely.

End of Section

SECTION 21 01 00

FIRE PROTECTION OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.

B. Instruct Owner's personnel in operation and maintenance of equipment and systems.

C. Submit three copies of complete manual in final form.

1.2 SUBMITTALS

A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect / Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
   1. Table of Contents for each element.
   2. Contractor information.
   3. All submittals, coordination drawings and product data, reviewed by the Architect / Engineer; bearing the Architect / Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
   4. All parts and maintenance manuals for items of equipment.
   5. Warranties (without starting dates).
   6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
   7. Operating and maintenance procedures.
   8. Form of Owner's Training Program Syllabus (including times and dates).
   9. Control operations/equipment wiring diagrams.
   10. Other required operating and maintenance information that are complete.

B. Copy will be returned to the Contractor within 15 days with comments for corrections.

C. Submit completed manuals in final electronic form to the Architect / Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.

D. The Architect / Engineer will review the manuals for completeness within fifteen (15) days.

E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.

F. Complete electronic manuals will be delivered to the Owner.

PART 2 - PRODUCTS

2.1 BINDERS

A. Commercial quality black three-ring binders with clear overlay plastic covers.

B. Minimum ring size: 1"; Maximum ring size: 3".

C. When multiple binders are used, correlate the data into related groupings.

D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

A. Form for Manuals:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
2. Format:
a. Size: 8-1/2" x 11".
b. Text: Manufacturer's printed data or neatly typewritten.
3. Drawings:
a. Provide reinforced punched binder tab and bind in text.
b. Fold larger drawings to size of text pages.
4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
a. Title of Project.
b. Identity of separate structures as applicable.
c. Identity of general subject matter covered in the manual.
6. Binder as specified.

B. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
a. Contractor, name of responsible principal, address and telephone number.
b. A list of each product required to be included, indexed to content of the volume.
c. List with each product, name, address and telephone number of:
1) Subcontractor or installer.
2) Maintenance contractor as appropriate.
3) Identify area of responsibility of each.
4) Local source of supply for parts and replacement.
d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
2. Product Data:
a. Include those sheets pertinent to the specific product
b. Annotate each sheet to:
1) Identify specific product or part installed.
2) Identify data applicable to installation.
3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.
3. Drawings:

a. Supplement product data with drawings as necessary to illustrate:
   1) Relations of component parts of equipment and systems.
   2) Control and flow diagrams.
b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
c. Do not use Project Record Documents as maintenance drawings.

4. Written text, as required to supplement product data for the particular installation:
   a. Organize in consistent format under separate headings for different procedures.
   b. Provide logical sequence of instructions for each procedure.
5. Copy of each warranty, bond and service contract issued.
   a. Provide information sheet for Owner's personnel, giving:
      1) Proper procedures in event of failure.
      2) Instances that might affect validity of warranties or bonds.
6. Shop drawings, coordination drawings and product data as specified.

C. Sections for Equipment and Systems.
1. Content for each unit of equipment and system as appropriate:
   a. Description of unit and component parts
      1) Function, normal operating characteristics, and limiting conditions.
      2) Performance curves, engineering data and tests.
      3) Complete nomenclature and commercial number of replaceable parts.
   b. Operating procedures:
      1) Start up, break-in, routine and normal operating instructions.
      2) Regulation, control, stopping, shut down and emergency instructions.
      3) Summer and winter operating instructions.
      4) Special operating instructions.
   c. Maintenance procedures:
      1) Routine operations
      2) Guide to trouble-shooting.
      3) Disassembly, repair and reassembly.
      4) Alignment, adjusting and checking.
      5) Routine service based on operating hours.
   d. Servicing and lubrication schedule. List of lubricants required.
   e. Manufacturer's printed operating and maintenance instructions.
   f. Description of sequence of operation by control manufacturer.
   g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
      1) Predicted life of part subject to wear.
      2) Items recommended to be stocked as spare parts.
   h. As installed control diagrams by controls manufacturer.
   i. Complete equipment internal wiring diagrams.
   j. Each Contractor's coordination drawings.
   k. As installed color coded piping diagrams.
   l. Charts of valve tag number, with location and function of each valve.
   m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
   n. Other data as required under pertinent sections of the specifications.
2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
4. Provide complete information for products specified in Division 21.

5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide backflow preventer certified test reports.

END OF SECTION

SECTION 21 05 00

FIRE PROTECTION GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Except as modified in this Section, General Conditions and Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 21 Fire Sprinkler Systems.

B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.2 CODE REQUIREMENTS AND FEES

A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.

B. Plumbing work shall comply with applicable inspection services:
1. Underwriters Laboratories.
2. National Fire Protection Association.
3. State Health Department.
4. Local Municipal Building Inspection Department.

C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.

D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.

E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:
1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 CONTRACT DRAWINGS

A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.

B. At the conclusion of project, obtain without cost to the Owner, PDF files of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain four sets of full-size prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (two sets are for the Owner's use, one set is for the Architect, and one set for Engineer's records). Delivery of these as-built prints and reproducibles is a condition of final acceptance. Provide record drawings in a digital format transmitted to the Owner, the Architect, and the Engineer.

C. As-Built drawings should indicate the following information as a minimum:
1. Indicate all addendum changes to documents.
2. Remove Engineer’s seal, name, address and logo from drawings.
3. Mark documents RECORD DRAWINGS.
4. Clearly indicate: DOCUMENT PRODUCED BY.
5. Indicate all changes to construction during construction. Indicate actual routing of all piping, etc. that were deviated from construction drawings.
6. Correct schedules to reflect (actual) equipment furnished and manufacturer.
7. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
8. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and plumbing valves.
9. Exact location of all electrical equipment in and outside of the building.
10. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
12. Cloud all changes.

1.7 SPACE REQUIREMENTS

A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.

B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.

C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.

D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.

E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

A. Manufacturers names and catalog number specified under sections of Division 21 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

B. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings or engineering parameters from those indicated on the Contract Documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance

from the system which these items are placed.

1.14 OPERATING TESTS

A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 HOUSEKEEPING PADS

A. Provide equipment housekeeping pads under all floor mounted and ground mounted plumbing equipment, and as shown on the drawings.

B. Concrete work as specified in Division 3.

C. Concrete pads:
1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
2. Chamfer strips at edges and corner of forms.
3. Smooth steel trowel finish.
4. Doweled to existing slab.

D. Install concrete curbs around multiple pipe penetrations.

3.3 VANDAL RESISTANT DEVICES

A. Provide a handle for each loose keyed operated valve and hose bibb on the project.

B. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.

C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.4 INSTRUCTION OF OWNER'S PERSONNEL

A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the plumbing systems.
   1. Provide the training during the Owner's regular working day.
   2. The instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems and with the project.

B. Time to be allocated for instructions.
   1. Minimum of 4 hours dedicated instructor time.
   2. 2 hours on each of 2 days.

C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
   1. One copy to the Owner.
   2. One copy to the Architect/Engineer.

D. The Owner will provide a list of personnel to receive instructions and will coordinate their attendance at the agreed upon times.

E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.

G. Demonstrate equipment functions (both individually and as part of the total integrated system).

H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.

J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.5 EQUIPMENT IDENTIFICATION

A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
   1. Designation approved by Architect/Engineer.
   2. Equipment includes, but is not limited to, water heaters, pumps, boilers and utility

controllers.

3. Submit schedule of equipment to be included and designations.

B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.6 OBSTRUCTIONS

A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.

1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 PROTECTION

A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

END OF SECTION

SECTION 21 05 10

FIRE PROTECTION CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Contract quality control including workmanship, manufacturer's instructions and demonstrations.

1.2 QUALITY CONTROL PROGRAM

A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Perform work by persons qualified to produce workmanship of specified quality.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.

D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence.

B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
   1. Field conditions.
   2. Condition of installation.
   3. Quality of workmanship.
   4. Start-up of equipment.
   5. Testing, adjusting, and balancing of equipment.

B. Representative shall make written report of observations and recommendations to Architect / Engineer.

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.1 PROTECTION OF EQUIPMENT

A. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the Contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION

SECTION 21 05 12

FIRE PROTECTION SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Prepare submittals as required by Division 1.

B. The term submittal, as used herein, refers to all:
1. Shop Drawings.
2. Coordination Drawings.
3. Product data.

C. Submittals shall be prepared and produced for:
1. Distribution as specified.
2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section.

1.2 SHOP DRAWINGS

A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.

B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.

C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.

D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: ¼” = 1’-0”.

B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.

C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
1. Actual mechanical equipment and components to be furnished.
2. Service clearance.
3. Relationship to other equipment and components.
4. Roof drains and leader piping.
5. Fire protection piping and equipment.

D. Identify field dimensions. Show relation to adjacent or critical features of work or products.

E. Related requirements:
   1. Ductwork shop drawings
   2. Coordination drawing specified in Division 26

F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.

B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.

C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.

D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: “Comply, ”Do Not Comply”, or “Not Applicable”. Explain all “Do Not Comply” statements.

F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

A. Review submittals prior to transmittal.

B. Determine and verify:
   1. Field measurements.
   2. Field construction criteria.
   3. Manufacturer's catalog numbers.
   4. Conformance with requirements of Contract Documents.

C. Coordinate submittals with requirements of the work and of the Contract Documents.

D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.

E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or

begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.

F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.

G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.

H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
   1. Proper sizes and capacities
   2. That the item will fit in the available space in a manner that will allow proper service.
   3. Construction methods, materials and finishes.

I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.

B. Number of submittals required:
   1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
   2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect / Engineer.

C. Accompany submittals with transmittal letter, in duplicate, containing:
   1. Date.
   2. Project title and number.
   3. Contractor's name and address.
   4. The number of each Shop Drawing, Project Datum and Sample submitted.
   5. Other pertinent data.

D. Submittals shall include:
   1. The date of submission.
   2. The project title and number.
   3. Contract Identification.
   4. The names of:
      a. Contractor.
      b. Subcontractor.
      c. Supplier.
      d. Manufacturer.
   5. Identification of the product.
   6. Field dimensions, clearly identified as such.
   7. Relation to adjacent or critical features of the work or materials.
   8. Applicable standards, such as ASTM or federal specifications numbers.
   9. Identification of deviations from contract documents.
   10. Suitable blank space for General Contractor and Architect / Engineer stamps.
   11. Contractor's signed and dated Stamp of Approval.

E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
   1. Finishes which involve Architect / Engineer selection of colors, textures or patterns.
   2. Associated items which require correlation for efficient function or for installation.

1.8 SUBMITTAL SPECIFICATION INFORMATION

A. Every submittal document shall bear the following information as used in the project manual:
   1. The related specification section number.
   2. The exact specification section title.

B. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

A. Make re-submittals under procedures specified for initial submittals.
   1. Indicate that the document or sample is a re-submittal.
   2. Identify changes made since previous submittals.

B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.

B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.

C. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.

D. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

A. The Architect / Engineer will:
   1. Review identified submittals with reasonable promptness and in accordance with schedule.
   2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal.
   3. Return submittals to Contractor for distribution or for resubmission.

B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.

C. Architect / Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
   1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
   2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.

D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

A. Do not make requests for substitution employing the procedures of this Section.

B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 21 10 00

FIRE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Design coordination of sprinkler work with the installations of other trades as shown on their drawings; all mechanical, electrical, plumbing and sprinkler work must fit the space requirements. The sprinkler work shall comply with other Sections of this specification; and fit the structure finishes. The Sprinkler Contractor will comply with all the codes and underwriter authorities, and the requirements for the installation of inside and outside piping; including sprinkler heads, valves, tamper switches, flow switches, hangers and supports, sleeves, fire department connections, inspector test connections, main drain and accessories, signs, and any other component parts reasonably incidental to providing a complete protection system. Provide 100 percent coverage for the entire building.

B. A wet system shall be installed in heated areas and dry pipe systems in areas subject to freezing. When heated areas are not available and dry pipe system not used, provide heat tracing and / or insulation installed per NFPA and per local Fire Marshall Requirements, or as indicated on drawings.

C. Furnish all articles of a completed sprinkler system including all materials, labor, tools, equipment, transportation services and supervision fees.

D. The plans provide a riser assembly location at water entry into building for flow switch locations, valve locations (with tamper switches), fire department test assemblies and fire department Siamese connections. These are a guide for subsequent preparation of the Contractor’s detailed installation drawings of the complete fire protection sprinkler system which shall be submitted to the Architect / Engineer for review. Submit only drawings and calculations bearing the approval of the authority having jurisdiction.

E. Do not exceed 52,000 square feet of building for each individual sprinkler system.

F. Install fire protective system identification signs in accordance with NFPA-13, NFPA-14, and NFPA-20

G. It shall be the fire protection installer’s responsibility to verify pressure at the project site by performing a flow test. Determine if the available static pressure, residual pressure, and flow rate will adequately provide the fire extinguishing system with the necessary operating requirements or if a fire pump, storage tank and necessary appurtenances are required. Notify Architect and Engineer if low water flow / pressure condition exist and inform them of all options prior to proceeding.

H. The installation of the entire Sprinkler Systems shall comply with all rules and regulations of the National Board of Fire Underwriters, the Local Building Code, Local Fire Marshall, and Requirements of NFPA Pamphlet 13, and other local authorities exercising jurisdiction.

I. Study the general, structural, electrical, and mechanical drawings and specifications, in order to become familiar with the building and details as they apply to the work of this Section. Cooperate with all Trades so that there will be no conflict of space. Plumbing flow lines, large ductwork HVAC piping and electrical service feeders shall take precedence over Fire Protection work, except where it is absolutely necessary to

maintain coverage protection.

J. Provide a water curtain sprinkler system along glazing to create a 1-hour rating, as outlined in NFPA 13. Refer to Architecture plans for locations. Water demand for water curtain shall be added to the ceiling sprinkler water demand at the point of connection, per NFPA 13. Sprinkler heads shall be spaced at 6’-0” o.c., minimum 6 inches and maximum 12 inches from glazing.

1.2 BASIS OF DESIGN

A. National Fire Protection Association (NFPA), latest edition of NFPA 13, Standard for the Installation of Sprinkler Systems.

B. Vertical zone valves installed in horizontal position are not acceptable. All zone valves are to be located at water entry into building and mounted in the vertical riser.

1.3 QUALITY ASSURANCE

A. Sprinkler equipment and installation to be in accordance with recommendations of and approved by local, state, and federal fire authorities.

B. Equipment and installation to meet requirements of NFPA No. 13, 14, 20, 24, 25, 70 and 72.

C. Use materials and equipment that are new and of unused, approved by NFPA and as listed in the UL list of "Inspected Fire Protection Equipment and Materials."

1.4 SHOP DRAWINGS

A. Make complete shop drawings and working drawings of equipment furnished, including detailed drawings of piping and sprinkler head locations. Drawings shall show construction details and dimensions of each piece of equipment and work to be installed. The location of all heads shall be as approved. Where additional heads are required to meet NFPA 13, provide at no additional cost.

B. Before the shop drawings are submitted to Architect / Engineer, submit drawings to the jurisdictions for approval. All approvals shall be noted on the drawings or by letter from the departments.

C. The Architect's approval of shop drawings shall not relieve the responsibility of correctly figured dimensions or any errors that may be contained in these drawings. The omission of any material shown on the contract drawings, or specified from the shop drawings, even though approved, shall not relieve the responsibility to furnish and erect them.

D. Provide ¼ scale drawings to show the location of the water entry into building with all zone valves, and shut-off valves, with alarms and drains at this location. Prepare the sprinkler drawings under the work of this Section.

E. Submit samples of all sprinkler types for approval.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Johnson Controls (Tyco Fire Products)
   1. Gem/Grinnell.

2. Central.
3. Star Sprinkler.

.

B. Automatic Sprinkler Company of America

C. Potter Roemer, Inc.

D. The Reliable Automatic Sprinkler Company.

E. Viking Corporation.

F. Victaulic Company of America.

G. Globe Fire Sprinkler Corporation.

2.2 PIPING AND FITTINGS

A. Above Slab Inside Building
1. Pipe 1-1/2" and Smaller: Schedule 40, black steel pipe conforming to ASTM A 795 or ASTM A135 joined with threaded fittings.
2. Pipe 1-1/2" and larger, provide ASTM A795 or ASTM A135 UL and FM listed.
a. Light wall having a minimum corrosion resistance ratio (CRR) or 1.00 or greater.
a. Schedule. 40 or Schedule 10, black steel pipe joined with rolled grooved fittings.

B. Underground within five feet of building. Provide ductile iron pipe, Class 200 conforming to ASTM, and ring-tite fittings. Provide concrete thrust blocks at changes in direction, according to the pipe manufacturer's recommendations.

C. Fittings used to join pipe shall be listed fabricated fittings or manufactured in accordance with the material and dimension standards listed in table 6.4.1 NFPA 13 and 2.2.1 NFPA 14.

2.3 SPRINKLER HEAD

A. All sprinklers shall comply with the latest requirements of NFPA 13 with respect to orifice size.

B. All heads shall be UL listed and/or FM approved and comply with the latest requirements of NFPA 13 with respect to orifice size unless otherwise noted. Sprinkler heads with “O” ring design shall not be acceptable.

C. Exposed areas:
1. Standard upright type with brass finish and escutcheon. Provide temperature rating per NFPA 13 and UL/FM approvals.
2. Tyco Model B, FRB, Globe Model GL-QR, GL-SR, or approved equal.

D. Sidewall applications:
1. Horizontal sidewall type with brass finishes and chrome escutcheon.
2. Unfinished areas and recessed with chrome plated escutcheon. Provide temperature rating per NFPA 13 and UL/FM approvals.
3. Tyco Model B, FRB, Globe Model GL-QR/SW, GL-SR/SW, or approved equal.

E. Suspended ceilings:
1. Adjustable drop-down deflector type concealed heads with manufacturer painted

white cover plate with glass bulb fusible link. Provide temperature rating per NFPA 13 and UL/FM approvals.
2. Color of plate, selected by Architect
3. Tyco Series RFII; Series ELOC, Globe Concealed Models GL-QR/INCH, GL-SW/INCH and GL-INCH/ECLH or approved equal.

F. Sprinklers subject to mechanical injury shall be protected with fusible solder type sprinklers and listed heavy duty bolt on guards. Bulb type sprinklers will not be acceptable for these locations.
1. Storage rooms with exposed structure.
2. Gymnasiums.
3. Mechanical and Electrical rooms.
4. Below exposed stairs.
5. Exposed structure areas.

2.4 INSPECTOR'S TEST CONNECTION

A. Provide inspector's test connection as required by NFPA 13.
1. Ductile iron module housing with combination sight glass, orifice, and bonnet assembly.
2. UL listed.
3. Victaulic No. 718.
4. Globe Model UTD.
5. Tyco, or approved equal.

2.5 TAMPER SWITCH / SUPERVISORY SWITCH

A. Tamper switch on each valve
1. Controlling or shutting off sprinkler system or any portion thereof.
2. Tamper switch with either one single pole, double throw switch or two single pole, double throw switches as required.
3. Switch shall be compatible with installed valve for standard mounting.
4. Potter-Roemer Fig. 6220, 6221, 6222, 6223 or approved equal.

2.6 FLOW SWITCH

A. Vane type flow switch.
1. Self-contained pneumatic, adjustable retard.
2. Two, single pole, double throw switches.
3. Red enamel tamper proof switch housing with flow paddle.
4. Potter Roemer Model No. 6200 or approved equal.

2.7 FLOORS AND CEILING PLATES

A. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas; size plates to fit pipe or insulation and lock in place.

2.8 GASKETS

A. Use 1/16-inch-thick preformed synthetic rubber bonded.

2.9 COUPLINGS

A. Use listed rolled grooved mechanical couplings to engage and lock grooved, or shouldered pipe ends and to allow for some angular deflection, contraction, and

expansion. Coupling consists of ductile iron housing, c-shaped composition sealing gasket and steel bolts. Gasket Material for dry pipe systems shall be silicone and listed for dry pipe service.

2.10 VALVES

A. Use valves suitable for 175 psig WOG.

B. Valves to be UL listed and FM approved.

C. Valve Connections:
1. Provide valves suitable to connect adjoining piping as specified for pipe joints. Use full line size valves unless noted otherwise.
2. Screwed ends for pipe sizes 2 inches and smaller.
3. Flanged ends for pipe sizes 2-1/2 inches and larger.
4. Solder or screw to solder adapters for copper tubing.
5. Use grooved body valves with mechanical grooved jointed piping.

D. Gate Valves:
1. Up to 2 inches, bronze, outside screw and yoke, rising stem, solid wedge, screwed ends, manufactured by: Mueller, or approved equal.
2. Over 2 inches, iron body, bronze trim, outside screw and yoke, rising stem, solid wedge, flanged ends; manufactured by Mueller, or approved equal.

E. Check Valves:
1. Up to 2-inch, bronze, regrind bronze swing disk, solder, or screwed ends; 200 WOG, manufactured by Mueller, or approved equal.
2. Over 2-inch, iron body bronze trim, swing disk, regrind – renew bronze disk and seat, flanged ends; 200 WOG, manufactured by Mueller, Globe Model RCV, or approved equal.

F. Butterfly Valve: Lug body style, bubble-tight shutoff, cast iron body, ASTM B 148 bronze disk, with integral tamper switch, manufactured by Anvil Model No. 8000 FP, or approved equal.

G. Backflow Preventer – Double Check valves:
1. 2 1/2” inches and over: ASSE 1015, double check backflow preventer with 2 independent spring loaded check valves, 2 isolation ball, OS&Y or butterfly valves with normally open tamper switch with double wire leads, 4 valve test ports. Constructed of bronze or epoxy coated cast iron or stainless steel body with bronze and plastic internal parts, stainless steel springs, silicone rubber valve discs, bronze seats, rated for 175 PSIG.

H. Freestanding Indicating Post: Install adjustable indicating post and valve outside building where shown on Civil drawings, consisting of UL/FM, non-rising stem gate valve and indicating post. Gate valve shall be iron body, non-rising stem, bronze mounted. Indicator flange, 175-psi non-shock rating, flanged end. Indicator shall be UL/FM approved cast iron body, Plexiglas window and 18-inch adjustment span with handle and tamper switch wired to main fire alarm control panel, manufactured by Mueller, Valve No. A-2052, Indicating Post No. A20800, or approved equal.

2.11 ELECTRIC ALARM BELL

A. 10-inch round red enamel steel bell with electrically operated vibrating outdoor alarm bell, UL listed, red enamel steel, manufactured by Simplex, or approved equal.

2.12 GAUGES

A. Gauges shall be bourdon tube type with minimum 4-1/2-inch dial and die cast aluminum case with screwed ring and black enamel finish. The movement shall be all stainless steel with Grade A phosphor bronze bourdon tube, brazed at socket and tip. The accuracy of the gauge shall be within one-half of one percent of the scale range. The pointer shall be the micrometer adjustment type recalibrated from the front. Pressure and compound gauges shall have suitable scale ranges and graduations. Suitable for temperatures up to 120 degrees F.

B. Gauges shall have ¼ inch connections and be mounted with combination stop / snubber needle valve with suitable pressure rating. Scale ranges: 0-200 psi.

C. Gauge range shall be such that system normal operating pressure falls with 25 percent and 75 percent of the full-scale range.

D. Pressure scale graduations shall read in psig. Figure intervals shall be in – 20 psig increments, with minor divisions in 2 psig increments.

E. The accuracy of the gauge shall be at least 0.5 percent of the scale range. Gauge shall be made in accordance with ASME B40.1 accuracy grade 2A.

F. Manufactured by:
   1. Trerice Model No. 4500 Series.
   2. Ashcroft.
   3. Marsh.
   4. Weksler.

2.13 SPARE SPRINKLER HEAD BOX

A. Provide baked enamel steel box to store 36 sprinkler heads (Minimum of 3 of each type used) for emergency replacement. Provide sprinkler wrench.

2.14 ALARM CHECK VALVE

A. Provide UL listed check valve.
   1. Variable for City Supplied systems pressure trim set.
   2. Constant for Fire Pump Systems pressure trim set.
   3. Tyco AV-1, Globe Model H, or approved equal.

2.15 SIAMESE FIRE DEPARTMENT CONNECTION

A. Siamese remote free standing fire department connection with chrome plated finish, local fire department thread, dust caps and chains, escutcheon, body, and ¾ inch automatic drip marked SPRINKLER – FIRE DEPARTMENT CONNECTION
   1. Coordinate type and location with local fire department.

PART 3 - EXECUTION

3.1 DESIGN

A. Design, spacing of sprinkler heads and selection sizes shall conform to the requirements of NFPA 13 for the indicated occupancy.

B. Uniform discharge density design shall be based on hydraulic calculations using the method outlined in NFPA 13. Density of discharge from sprinkler heads shall conform to

NFPA 13.

C. Friction losses in pipe will be based on a value of “C” = 120 in the Hazen and Williams formula.

D. Design and install the system so that no part will interfere with doors, windows, heating, mechanical, lighting, or electrical equipment. Do not locate sprinkler heads closer than 3 feet to lighting fixtures or other obstructions.

3.2 LOCATION

A. Heads shown, if indicated on reflected ceiling plans, are an integral part of the ceiling design. Where heads are not shown or indicated, locate them in the exact center of acoustical ceiling tile unless noted otherwise. In rooms with monolithic plaster or gypsum drywall ceilings, locate the sprinkler heads symmetrically arranged with respect to both axes of the room. Locate sprinkler heads in relation to specialty ceiling elements such as slats, ribs, panels, grids, etc., if not shown on the drawings. Generally, locate heads in the exact center of, or spaced between, such elements. Center heads in corridors.

B. Locate heads as may be required for coordinated ceiling pattern, even through number of heads exceed minimum code requirements.

C. Sprinkler heads located in utility or mechanical rooms, penthouses, service corridors, or other such spaces not subject to public view need not be centered in ceiling patterns and may use a straight drop from branch line.

3.3 PREPARATION

A. Ream pipes and tubes, clean off scale, rust, oxide, and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.

B. Pipe beveled each end, per approved procedures.

C. Hammer clean and flush out piping after welding to remove scale, welding slag and other debris.

3.4 CONNECTION

A. Make screwed joints with square, clean full cut standard taper pipe threads. Ream after cutting and threading. Red lead and linseed oil or other approved non-toxic joint compound applied to male threads only.

B. Nipples: Shoulder type; extra heavy where less than 1-1/2 inch is unthreaded.

C. Clamp cast iron water pipe at fittings with ¾ inch rods and properly anchor and support.

D. Use grooved mechanical couplings and mechanical fasteners only in accessible locations.

3.5 COORDINATION

A. Coordinate the installation schedule for this work with the construction schedule for the Work to ensure orderly progress with minimum delay.

B. Coordinate interface of fire sprinkler system with the work of other trades to ensure

proper and adequate provision for the installation and connection of this system.

C. Coordinate location and quantity of Siamese connections required for fire department connection with Architect and local fire officials.

3.6 SURFACE CONDITIONS

A. Before starting each stage of the fire sprinkler systems installation, inspect the installed work of other trades and determine that work is complete enough to allow installation to begin. Ensure that work of other trades has been installed in a manner to permit work of this Section in accordance with approved design.

3.7 INSTALLATION

A. Run piping concealed above furred ceilings and in joists to minimize obstructions. Expose only heads.

B. Protect sprinkler heads against mechanical injury with heavy duty bolt-on guards.

C. Locate system drains and inspector’s test connections in utility rooms, mechanical rooms or other readily accessible areas not requiring access through ceiling. Coordinate sprinkler system drain flow rates with plumbing system drainage capacities.

D. Where low points or drains occur above ceilings or in otherwise finished spaces, furnish drain valve with brass cap and chain.

E. Locate outside alarms on wall of building and coordinate with Architect.

G. Provide on interior wall near sprinkler valve, cabinet containing extra sprinkler heads of each type and wrench suitable for each head type.

H. Provide a minimum 18-inch radius swing joint for each drop to sprinkler heads located in ceilings.

I. Provide Easy-Flex or Flexhead Industries sprinkler hose fittings for each sprinkler head installation for hydraulically designed wet or dry pipe sprinkler connections per NFPA 13. Minimum bend radius per UL.

J. Install pipe markers to identify fire protection.

K. Provide shield or deflector for sprinklers or equipment where electrical switchgear, switchboards and motor control centers are in sprinkler protected spaces.

L. Install remote fire department valve, complying with NFPA.

M. During construction, make one standpipe outlet available on each floor without delay, for fire department use.

Q. Install valves with stems upright or horizontal, not inverted.

R. Sprinkler heads shall be installed above and below ductwork over 48 inches wide, in exposed areas, per NFPA 13.

S. Install the complete fire sprinkler system in accordance with the approved shop drawings.

T. Perform piping installation in accordance with the provisions of the specifications,

including furnishing of required sleeves for fire sprinkler system pipes passing through rated walls, floors, and other parts of the building. Provide scheduled 40 galvanized pipe sleeve for concrete or CMU penetrations. Furnish size required for fireproofing and or insulation. Furnish and install split wall plates and chrome plated escutcheons for exposed fire sprinkler system pipes. Where pipes pass through concrete floors, furnish, and install wrought iron or steel pipe sleeves made flush with the ceiling below and extending 2" above the finished floor.

U. Do not cut or make holes in any part of the building except where shown on the approved shop drawings.

V. Furnish and install, next to the sprinkler riser main, a print sheet protected by glass or a transparent plastic cover, giving brief instructions regarding control, emergency procedure, and other data required by NFPA #13. For hydraulically designed sprinkler systems, a placard is to be permanently attached to the riser indicating the location, and the basis of design (discharge density and system demand).

W. Do not install exposed piping below structure in public area.

X. Provide heat tracing and insulation on wet piping systems exposed to freezing when not installed in a heated space or installed by other acceptable methods of maintaining the piping from freezing. Installation of heat tracing and insulation shall be in accordance with the latest edition of NFPA 13 and the local code authorities. Coordinate electrical requirements with Division 26.

3.8 SECURING AND SUPPORTING

A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved adjustable ring type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved adjustable ring type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging.

B. Provide supports both sides of elbows for pipe 6" and larger.

C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed.

D. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Steel Max. Support Spacing, Feet	Minimum Rod Diameter, Inches
1" & smaller	6	3/8
1-1/4" & 1-1/2"	8	3/8
2"	10	3/8
3"	10	1/2
4" & 5"	10	5/8
6" and above	10	3/4

3.9 PIPE SUPPORTS

A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe

support. Hot-dip galvanize members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.

B. Adjustable ring type hangers shall be used for single pipe supports; Erico Model 115 NFPA UL/FM. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. All parts shall be zinc plated carbon steel, or galvanized.

3.10 PIPE SLEEVES

A. Sleeves through masonry and concrete construction:
   1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
   2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.

B. Sleeves through gypsum wall construction.
   1. Fabricate sleeves of 16-gauge galvanized sheet metal.

C. Sleeves through elevated slab construction.
   1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.

D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2” above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.

E. Caulk sleeves water and airtight. Seal annular space between pipes and sleeves with mastic compound to make the space water and airtight.

F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.

G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.

H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.11 CLEANING OF PIPING SYSTEMS

A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge, and circulate.

3.12 FLUSHING AND TESTING

A. Testing and flushing of installation of sprinkler system shall be in accordance with NFPA 13, and NFPA 25.

B. Flush sprinkler piping in accordance with NFPA 13. Additionally, flush all alarm valves, and all main piping up to valve.

C. In addition to NFPA 13 required tests, provide flow switch test and tamper switch test for each device, and verify alarm valve operation.

D. All tests shall be witnessed by Architect / Engineer. Contractor shall notify Architect / Engineer 7 working days in advance.

3.13 EXCAVATING, TRENCHING, AND BACKFILLING

A. Perform excavation, trenching, and backfilling for this portion of the work in accordance with the specifications.

3.14 PIPE MARKERS

A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers or equal, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows, and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.

B. Install identification in the following locations:
1. Both sides of penetrations through walls, floors, and ceilings.
2. Close to valves or flanges.
3. Intervals on straight pipe runs not to exceed 50 feet
4. Apply marker where view is obstructed.

C. Pipe markers shall meet or exceed the specifications of the ASME A13.1 “Scheme for Identification of Piping Systems”.

3.15 TESTING AND ACCEPTANCE

A. Prior to connecting to the overhead sprinkler piping, flush the underground main. Secure required approvals of the flushing operations.

B. Upon completion of the fire sprinkler system installation, test and retest the complete installation and make corrections as necessary to obtain acceptance by the Fire Marshall and/or any other authority having jurisdiction. Furnish test equipment and personnel required.

3.16 TRAINING

A. At a time mutually agreed upon, provide 4 hours of instruction to the Owner’s designated personnel on the operation and maintenance of the automatic sprinkler system and associated equipment. Owner’s Operation and Maintenance Manual prepared for this project shall be used during the instruction.

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SECTION 22 01 00

PLUMBING OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.

B. Instruct Owner's personnel in operation and maintenance of equipment and systems.

C. Submit three copies of complete manual in final form.

1.2 SUBMITTALS

A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect/Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
   1. Table of Contents for each element.
   2. Contractor information.
   3. All submittals, coordination drawings and product data, reviewed by the Architect / Engineer; bearing the Architect / Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
   4. All parts and maintenance manuals for items of equipment.
   5. Warranties (without starting dates)
   6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
   7. Operating and maintenance procedures.
   8. Form of Owner's Training Program Syllabus (including times and dates).
   9. Control operations/equipment wiring diagrams.
   10. Other required operating and maintenance information that are complete.

B. Copy will be returned to the Contractor within 15 days with comments for corrections.

C. Submit completed manuals in final electronic form to the Architect / Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.

D. The Architect/Engineer will review the manuals for completeness within fifteen (15) days.

E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.

F. Complete electronic manuals will be delivered to the Owner.

PART 2 - PRODUCTS

2.1 BINDERS

A. Commercial quality black three-ring binders with clear overlay plastic covers.

B. Minimum ring size: 1 inch; Maximum ring size: 3 inches.

C. When multiple binders are used, correlate the data into related groupings.

D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

A. Form for Manuals:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
2. Format:
a. Size: 8-1/2 inch x 11 inch.
b. Text: Manufacturer's printed data or neatly typewritten.
3. Drawings:
a. Provide reinforced punched binder tab and bind in text.
b. Fold larger drawings to size of text pages.
4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
a. Title of Project
b. Identity of separate structures as applicable.
c. Identity of general subject matter covered in the manual.
6. Binder as specified.

B. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
a. Contractor, name of responsible principal, address and telephone number.
b. A list of each product required to be included, indexed to content of the volume.
c. List with each product, name, address and telephone number of:
1) Subcontractor or installer.
2) Maintenance contractor as appropriate.
3) Identify area of responsibility of each.
4) Local source of supply for parts and replacement.
d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
2. Product Data:
a. Include those sheets pertinent to the specific product.
b. Annotate each sheet to:
1) Identify specific product or part installed.
2) Identify data applicable to installation.
3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.
3. Drawings:
a. Supplement product data with drawings as necessary to illustrate:
1) Relations of component parts of equipment and systems.
2) Control and flow diagrams.
b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
c. Do not use Project Record Documents as maintenance drawings.

4. Written text, as required to supplement product data for the particular installation:
    a. Organize in consistent format under separate headings for different procedures.
    b. Provide logical sequence of instructions for each procedure.
5. Copy of each warranty, bond and service contract issued.
    a. Provide information sheet for Owner's personnel, giving:
        1) Proper procedures in event of failure.
        2) Instances that might affect validity of warranties or bonds.
6. Shop drawings, coordination drawings and product data as specified.

C. Sections for Equipment and Systems.
1. Content for each unit of equipment and system as appropriate:
    a. Description of unit and component parts.
        1) Function, normal operating characteristics, and limiting conditions.
        2) Performance curves, engineering data and tests.
        3) Complete nomenclature and commercial number of replaceable parts.
    b. Operating procedures:
        1) Start up, break-in, routine and normal operating instructions.
        2) Regulation, control, stopping, shut down and emergency instructions.
        3) Summer and winter operating instructions.
        4) Special operating instructions.
    c. Maintenance procedures:
        1) Routine operations
        2) Guide to trouble-shooting.
        3) Disassembly, repair and reassembly.
        4) Alignment, adjusting and checking.
        5) Routine service based on operating hours.
    d. Servicing and lubrication schedule. List of lubricants required.
    e. Manufacturer's printed operating and maintenance instructions.
    f. Description of sequence of operation by control manufacturer.
    g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
        1) Predicted life of part subject to wear.
        2) Items recommended to be stocked as spare parts.
    h. As installed control diagrams by controls manufacturer.
    i. Complete equipment internal wiring diagrams.
    j. Each Contractor's coordination drawings.
    k. As installed color coded piping diagrams.
    l. Charts of valve tag number, with location and function of each valve.
    m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
    n. Other data as required under pertinent sections of the specifications.
2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
4. Provide complete information for products specified in Division 22.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide backflow preventer certified test reports.
10. Provide gas piping pressure test reports.

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SECTION 22 05 00

PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 22 Plumbing.

B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.2 CODE REQUIREMENTS AND FEES

A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.

B. Plumbing work shall comply with applicable inspection services:
1. Underwriters Laboratories.
2. National Fire Protection Association.
3. State Health Department.
4. Local Municipal Building Inspection Department.

C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.

D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.

E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:
1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system
2. Able to furnish evidence of having contracted for and installed not less than three systems of comparable size and type that has served their Owners satisfactorily for not less than three years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 CONTRACT DRAWINGS

A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.

B. At the conclusion of project, obtain without cost to the Owner, PDF files of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain four sets of full size prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (two sets are for the Owner's use and one set is for the Architect and one set for Engineer's records). Delivery of these as-built prints and reproducibles is a condition of final acceptance. Provide record drawings in a digital format transmitted to the Owner, the Architect, and the Engineer.

C. As-Built drawings should indicate the following information as a minimum:
1. Indicate all addendum changes to documents.
2. Remove Engineer’s seal, name, address and logo from drawings.
3. Mark documents RECORD DRAWINGS.
4. Clearly indicate: DOCUMENT PRODUCED BY
5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
6. Indicate exact location of all underground plumbing and flow line elevation.
7. Indicate exact location of all underground plumbing piping and elevation.
8. Indicate exact location of all underground electrical raceways and elevations.
9. Correct schedules to reflect (actual) equipment furnished and manufacturer.
10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and plumbing valves.
12. Exact location of all electrical equipment in and outside of the building.
13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
15. Cloud all changes.

1.7 SPACE REQUIREMENTS

A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.

B. Because of the complicated relationship of this work to the total project, conscientiously

study the relation and cooperate as necessary to accomplish the full intent of the documents.

C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.

D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.

E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

A. Guarantee work for one year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

A. Manufacturers names and catalog number specified under sections of Division 22 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the Contract Documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed. Any redesign costs associated with the integration of substitute equipment into the existing Contract Documents, shall be billed by the Architect/Engineers, on an hourly basis, to the substituting contractor. Resulting change orders from the redesign are the sole responsibility of the substituting contractor.

B. Written notification of intent to use manufacturers other than those specified is required ten days prior to bid. Submittals shall be reviewed only after bidding and may be rejected if any

aspect of the equivalent product is deemed lesser than that of the specified product by the specifier. The contractor shall be responsible for ensuring alternates are equivalent to those specified. Submit a marked-up set of the relevant specification section indicating all variances, a comparison to the specified product, and of construction and performance criteria, complete design and performance data for the specified product and the proposed substitution for comparison to the Engineer. The Architect issues approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.

1.14 OPERATING TESTS

A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit three copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

A. Submit three copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each subcontractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 HOUSEKEEPING PADS

A. Provide equipment housekeeping pads under all floor mounted and ground mounted plumbing equipment, and as shown on the drawings.

B. Concrete work as specified in Division 3.

C. Concrete pads:
   1. 4 inch high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
   2. Chamfer strips at edges and corner of forms.
   3. Smooth steel trowel finish.
   4. Doweled to existing slab

D. Install concrete curbs around multiple pipe penetrations.

3.3 VANDAL RESISTANT DEVICES

A. Provide a handle for each loose keyed operated valve and hose bibb on the project.
B. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner two suitable tools for use with each type of fastener used.
C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.4 INSTRUCTION OF OWNER'S PERSONNEL

A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the plumbing systems.
   1. Provide the training during the Owner's regular working day.
   2. The Instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems and with the project.

B. Time to be allocated for instructions.
   1. Minimum of 8 hours dedicated instructor time.
   2. 4 hours on each of 2 days.

C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
   1. One copy to the Owner.
   2. One copy to the Architect / Engineer.

D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.

E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.

G. Demonstrate equipment functions (both individually and as part of the total integrated system).

H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.

J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.5 EQUIPMENT IDENTIFICATION

A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
   1. Designation approved by Architect / Engineer.
   2. Equipment includes, but is not limited to, water heaters, pumps, boilers and utility controllers.
   3. Submit schedule of equipment to be included and designations.

B. Provide nameplates with ½ inch high letters and fastened with epoxy or screws.

3.6 OBSTRUCTIONS

A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
   1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
   2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 PROTECTION

A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

END OF SECTION

SECTION 22 05 10

PLUMBING CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Contract quality control including workmanship, manufacturer's instructions and demonstrations.

1.2 QUALITY CONTROL PROGRAM

A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Perform work by persons qualified to produce workmanship of specified quality.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.

D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence.

B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
   1. Field conditions.
   2. Condition of installation.
   3. Quality of workmanship.
   4. Start-up of equipment.
   5. Testing, adjusting, and balancing of equipment.

B. Representative shall make written report of observations and recommendations to Architect / Engineer.

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS

PART 3 - EXECUTION

3.1 PROTECTION OF EQUIPMENT

A. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the Contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION

SECTION 22 05 12

PLUMBING SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Prepare submittals as required by Division 1.

B. The term submittal, as used herein, refers to all:
1. Shop Drawings.
2. Coordination Drawings.
3. Product data.

C. Submittals shall be prepared and produced for:
1. Distribution as specified.
2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section.

1.2 SHOP DRAWINGS

A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.

B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.

C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.

D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: ¼ inch = 1 foot - 0 inch.

B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.

C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
1. Actual mechanical equipment and components to be furnished.
2. Service clearance.
3. Relationship to other equipment and components.
4. Roof drains and leader piping.
5. Fire protection piping and equipment.

D. Identify field dimensions. Show relation to adjacent or critical features of work or products.

E. Related requirements:
1. Ductwork shop drawings.

2. Coordination drawing specified in Division 26.

F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.

B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.

C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.

D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: “Comply, ”Do Not Comply”, or “Not Applicable”. Explain all “Do Not Comply” statements.

F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

A. Review submittals prior to transmittal.

B. Determine and verify:
1. Field measurements.
2. Field construction criteria.
3. Manufacturer's catalog numbers.
4. Conformance with requirements of Contract Documents.

C. Coordinate submittals with requirements of the work and of the Contract Documents.

D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.

E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect/Engineer's acceptance.

F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect/Engineer reviews submittals or not.

G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect/engineer gives written acceptance of the specific deviations on reviewed documents.

H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
   1. Proper sizes and capacities.
   2. That the item will fit in the available space in a manner that will allow proper service.
   3. Construction methods, materials and finishes.

I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.

B. Shop drawing submittals required:
   1. Shop drawing submittals shall be individually submitted by specification section number in PDF format. Combined submittals will be returned for contractor to divide.
   2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect/Engineer.

C. Accompany submittals with transmittal letter, containing:
   1. Date.
   2. Project title and number.
   3. Contractor's name and address.
   4. The number of each Shop Drawing, Project Datum and Sample submitted.
   5. Other pertinent data.

D. Submittals shall include:
   1. The date of submission.
   2. The project title and number.
   3. Contract Identification.
   4. The names of:
      a. Contractor.
      b. Subcontractor.
      c. Supplier.
      d. Manufacturer.
   5. Identification of the product.
   6. Field dimensions, clearly identified as such.
   7. Relation to adjacent or critical features of the work or materials.
   8. Applicable standards, such as ASTM or federal specifications numbers.
   9. Identification of deviations from contract documents.
   10. Suitable blank space for General Contractor and Architect/Engineer stamps.
   11. Contractor's signed and dated Stamp of Approval.

E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
   1. Finishes which involve Architect/Engineer selection of colors, textures or patterns
   2. Associated items which require correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

A. Every submittal document shall bear the following information as used in the project manual:
   1. The related specification section number.
   2. The exact specification section title.

B. Submittals delivered to the Architect/Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

A. Make re-submittals under procedures specified for initial submittals.
   1. Indicate that the document or sample is a re-submittal.
   2. Identify changes made since previous submittals.

B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.

B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect/Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.

C. Do not deliver any submittals to the Architect/Engineer that do not bear the Contractor's stamp of approval and signature.

D. Submittals delivered to the Architect/Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT/ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

A. The Architect/Engineer will:
   1. Review identified submittals with reasonable promptness and in accordance with schedule.
   2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal.
   3. Return submittals to Contractor for distribution or for resubmission.

B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.

C. Architect/Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
   1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.

2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.

D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

A. Do not make requests for substitution employing the procedures of this Section.

B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 22 05 15

PLUMBING EARTHWORK

PART 1 - GENERAL

A. Excavate and backfill for pipe trenches for underground piping, and excavate for structures installed as part of plumbing work.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavate trenches for exterior underground piping to the required depth to ensure 2 foot minimum coverage over piping.

B. Cut the bottom of the trench or excavation to uniform grade.

C. Should rock be encountered, excavate 6 inches below grade, fill with bedding material and tamp well.

D. Lay out alignment of pipe trenches to avoid obstructions. Assure that proposed route of pipe will not interfere with building foundation before any cutting is begun. Should interference be found, contact the Architect/Engineer before proceeding.

3.2 BACKFILL

A. Backfill shall not be placed until the work has been inspected, tested and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable friable soils from other excavation as backfill material. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in Division 2.

B. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to optimum moisture content. Compact with power-driven tampers to the prescribed density. Place regular backfill in 8 inch maximum layers, loose measure. Compact to not less than 95 percent of maximum soil density as determined by ASTM D-698 Standard Proctor.

C. Restoration. Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks, and similar areas, to a condition equal to the adjacent undisturbed earth, and restore surface of the area to the condition existing prior to trenching or excavating operation.

D. Provide 6 inch stabilized sand bed with 4 inch stabilized sand cover around each pipe.

3.3 DISPOSAL OF EXCESS MATERIAL

A. Remove excess excavation material or material unsuitable for backfill. Excess material can be spread on grade, or shall be removed from site as directed by the Owner/Architect.

END OF SECTION

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SECTION 22 05 17

PLUMBING ACCESS DOORS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install access doors in wall or ceiling locations as required or shown for access to valves, controls, regulating devices, water arresters and other equipment requiring maintenance, adjustment or operation.

PART 2 - PRODUCTS

2.1 NON-FIRE RATED ACCESS DOORS

A. 16-Gauge frames.

B. 14-gauge steel panels.

C. Continuous fully concealed hinges.

D. Cylinder lock with key.

E. Prime coat finish.

F. Brushed satin stainless steel finish for restroom, kitchen or cafeteria installation.

G. Material suitable for wall and/or ceiling mounting.

2.2 FIRE RATED ACCESS DOORS

A. UL listed, 1-1/2 hour Label “B”, access doors.

B. 16-Gauge stainless steel.

C. 20-Gauge insulated sandwich-type door panel.

D. Two inch thick with fire rated insulation.

E. Continuous fully concealed hinge.

F. Automatic closing and latching mechanism.

G. Knurled knob and recessed key operation for Owner selection.

H. Interior latch release slide for opening from inside.

I. Prime coat finish.

J. Material suitable for wall and/or ceiling mounting.

2.3 ACCEPTABLE MANUFACTURERS

A. Milcor.
B. MIFAB.

C. Acudor.
D. Elmdor.
E. Or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Access doors specified in Division 22 will be installed by other crafts. Not all required access doors are shown. Coordinate with the Contractor to locate access doors for ease of operation and maintenance of concealed equipment.

B. Installation shall be in accordance with the manufacturer's printed instructions.

C. Minimum size required:
1. 24 inch x 24 inch for plumbing multiple isolation valves and electrical related items in ceilings.
2. 12 inch x 12 inch for plumbing for single isolation valve.

END OF SECTION

SECTION 22 05 19

PRESSURE AND TEMPERATURE INSTRUMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section specifies gauges, thermometers, wells and/or pressure and temperature test stations to be installed as specified.

1.2 RELATED WORK

A. Division 22, Plumbing
   1. Plumbing General Provisions.
   2. Pipe and Pipe Fittings, General.
   3. Valves, Strainers and Vents.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - GAUGES AND THERMOMETERS

A. Trerice.
B. Taylor.
C. Marsh.
D. Weksler.
E. Weiss.
F. or approved equal.

2.2 PRESSURE GAUGES

A. Case and Ring: 4 inch type 304 stainless steel; liquid filled case with stainless steel bayonet ring.

B. Dial: White aluminum with black markings.

C. Window: Clear acrylic.

D. Tube: Phosphor bronze and forged brass socket.

E. Gauge accuracy: +/- 1 percent over operating range.

F. For pulsating service, provide impulse dampers.

G. Without flange for pipe mounting.

H. With flange for wall mounting.

I. Weiss Model: Domestic Water 4CTS LF (Lead Free) 0-100 PSI.

2.3 THERMOMETER WELLS

A. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction (Lead Free).

B. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.

C. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.

D. Wells shall be sized to extend a minimum of 50 percent into pipe.

2.4 THERMOMETERS IN PIPING SYSTEMS OR VESSELS

A. Die cast aluminum case with baked epoxy finish.

B. Adjustable angle 9 inch scale length.

C. Clear acrylic window.

D. Brass stem, length to match well.

E. Red or blue reading organic spirit filled-in magnifying glass column.

F. White background with black figures and markings.

G. Brass stems and union connections (Lead Free).

H Accuracy: +/- 1 percent of scale range.

I. Range:
1. Hot water lines: 30 deg. F to 240 deg. F.

2.5 PRESSURE AND TEMPERATURE TEST STATIONS

A. "Test Station" fitting to receive either a temperature or pressure probe. Fitting shall be solid brass with two valve cores of Nordel (Lead Free).
1. Fitted with a color coded cap strap with gasket.
2. Acceptable Manufacturer: Peterson Equipment Company.
3. Provide with extension neck to match insulation thickness.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with drawing details and manufacturer's recommendations.

B. Provide a ball valve at each gauge (Lead Free).

C. Locate gauges and thermometers to be easily readable from the floor at a 5 foot-6 inch eye level. Use adjustable angle or rigid stem as required. Install gauges in upright position.

D. Install pressure gauges in the following locations: across pumps, domestic water service entrance. Pressure scale range 0 to 160 PSI.

E. Install thermometer in the following locations: At hot water supply at tank water heater.
1. Hot water lines: 30 deg. F to 240 deg. F.

END OF SECTION

SECTION 22 05 23

VALVES, STRAINERS AND VENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Plumbing Valves

B. Pipe strainer and suction diffusers.

PART 2 - PRODUCTS

2.1 VALVES

A. Pressure Ratings:
1. Unless otherwise indicated, use valves suitable for 125 minimum psig working steam pressure (WSP) and 450 deg. F.
2. The pressure temperature rating of valves shall be not less than the design criteria applicable to components of the system.

B. Balancing Valves (Manual)
1. Provide balancing valves with:
a. Corrosion resistant plug with resilient seal when required.
b. O-ring stem seal.
c. Permanently lubricated, corrosion resistant bearings.
2. Connections
a. Through 2-inch pipe size use threaded connections.
3. Provide each valve with:
a. Memory stop.
b. Plastic drip cap.
c. 1/8-inch gauge tap.
4. All valves for domestic use must be lead free.

D. Ball Valves
1. Provide ball valves with:
a. Blowout proof stem.
b. Full size port, 316 stainless steel ball and stem.
c. Cast bronze body.
d. Threaded ends.
2. Seat, seals, thrust washers and packing shall be suitable for the intended service.
3. Service rating:
a. 150 psi saturated steam.
b. 600 psi WOG.
4. Provide with memory stop for balancing valves.
5. Where Viega ProPress fittings are used, Viega ProPress ball valves may be used.
6. All valves for domestic use must be lead free.

E. Thermostatic Mixing Valves
1. Manufacturers:
a. Watts.
b. Caleffi.
c. Lawler.

d. Or approved equal.

2. Valve: Lead free brass body, stainless steel or copper alloy, integral temperature adjustment, check valves. At fixture ASSE 1070.

F. Valve Connections
1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves. Sweated joints are not allowed.
2. Thread pipe sizes 2 inches and smaller.
3. Flange pipe sizes 2-1/2 inches and larger.
4. Use screw to solder adapters for copper tubing.
5. Use grooved body valves with mechanical grooved jointed piping.
6. Use press valves when using copper press systems.

G. Check Valves
1. Bronze body, 2 inches and smaller, bronze disc (Teflon disc for steam service), regrinding swing check, screw-in cap, threaded connection (Lead Free).
2. Iron body, 2-1/2 inches and larger, bronze trim, non-slam: stainless steel pins and springs, and bronze plate or bronze mounted, regrind-renew check, bronze seat ring and disc. Provide either wafer or threaded lug (Lead Free).

H. Provide valves of same manufacturer throughout where possible.

I. Provide valves with manufacturer's name and manufacturing location, duty and pressure rating clearly marked on outside of body.

J. Where valves are installed in insulated piping, provide with extended neck so valve operator and stop plate clears the full thickness insulation.

K. Provide valve, seat and trim materials suitable for the intended service.

L. Provide memory stops for all valves used for throttling service. Valves for throttling service shall be butterfly, plug, globe or ball type.

2.2 PIPE SYSTEMS STRAINERS

A. Body:
1. Bronze "Y" pattern or basket as shown on the drawings.
2. Line size.
3. Threaded strainer blow down port.
4. ASTM A #126 Class B Cast Iron Body.

B. Construction:
1. 2 inch size and smaller with screw connections rated 400 psi WOG.
2. Over 2 inch size with flanged connections, rated 125 psi WOG.

C. Fabricate screens of Monel or type 304 stainless steel:
1. With 20 mesh woven wire in piping systems through 2 inches.
2. With 0.045 perforations in piping systems 2-1/2 inches and 3 inches.
3. With 0.125 perforations in piping systems 4 inches and larger.

D. Start-up:
1. Provide an additional fine mesh disposable screen for use during start-up operations.
2. Remove after 30 days.
3. Attach to piping for Owner’s review.

E. Acceptable Manufacturers (All listed must be lead free):
1. Apollo.
2. Crane.
3. Mueller.
4. Nibco.
5. Zurn.
6. Or approved equal.

2.3 VALVE SCHEDULE

A. Domestic Service
1. Gas shut-off service: UL approved for natural gas service.
a. Nibco Ball Valve, full port through 1 inch: T-585-70-UL.
b. Nibco Ball Valve conventional port 1-1/4 inch through 3 inch: T-580-70-UL.
Mueller 1-1/4 inch through 4 inch: Lub-O-seal.
c. Milwaukee Full Port ¼ inch-2 inch.
d. Or approved equal.
2. Cold and Hot water service (all listed must be Lead Free):
a. Nibco Ball Valve full port through 2 inch: T-585-66-LF.
b. Nibco Ball Valve 2-1/2 inch and 3 inch conventional port: T-580-66-LF.
c. Viega ProPress Bronze Ball Valves (where Viega ProPress fittings are used).
d. Milwaukee Full Port ¼ inch-2 inch.
e. Milwaukee Standard Port 2-1/2 inch & 3 inch.
f. Apollo Press Bronze Ball valves – 77 WLF.
g. Or approved equal.
3. Check Valve (All listed must be Lead Free):
a. Nibco Check Valve: T - 413 - Y -LF (Teflon Seats).
b. Milwaukee Valve – 509T.
c. Apollo Check Valve: 163TLF.
d. Apollo Press Check Valve: 163TPR-LF.
e. Apollo Check Valve 2 inch and larger 910WE-LF (Wafer).
f. Or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install valves for shut-off and isolating service at each piece of equipment, at vertical risers, and where shown on the drawings.

C. Use ball valves in domestic hot water and domestic cold water systems.

D. Provide drain valves at main shut-off valves and low points of piping and apparatus so the systems can be entirely drained.
1. 1 inch valve for pipes 6 inch and larger.
2. 3/4 inch valve for pipes smaller than 6 inch.
3. Terminate with pipe plug.
4. Drain valves shall be ball valves.

E. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibbs, and where shown on the drawings.

F. Where valves are installed in insulated pipe, valve operator shall have an insert so the lever or handle will not damage the insulation. Install handles so the lever or handles will not damage the insulation.

G. Provide clearance for installation of insulation and access to valves.

H. Provide access where valves are not exposed.

I. Install backflow preventers in accordance with Oklahoma requirements maintaining minimum clearance distances for servicing and testing. Provide indirect waste piping with air gap installation from relief opening to above hub drain or floor drain.

3.2 VALVE TAGS

A. Furnish valves with 1-1/2 inch diameter brass valve tags with stamped, black or red-filled numbers. Service designations shall be 1/4 inch letters, and valve numbers shall be 2 inch letters. Engineer shall approve Service designations. Secure tags to valves by use of brass "S" hooks or brass chain. Secure chain to valve by use of copper or Monel meter seals. Valve tags are not required if the valve is located within 3 feet of the equipment being served and the service is obvious.

B. Mount charts and drawings listing functions of each valve and its location in a metal and glass frame. Place charts and drawings as directed; in addition, on the record drawings mark the symbols and furnish a valve schedule properly identifying the valve number, service, exact location, the material being piped, and the room number of area that the valve services. This schedule shall be furnished on reproducible drafting paper or film suitable for reproduction on an Ozalid machine. The Owner shall approve the size of drafting paper. Provide a copy of the valve chart in the Operating and Maintenance Manuals.

3.3 PIPE SYSTEMS STRAINERS

A. Provide strainers in supply piping to circulating pumps, thermostatic mixing valves, before solenoid valves and trap primer valves.

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install piping insulation, jackets, accessories and covering of specified materials. The insulation shall be used for high and low temperature piping applications including domestic hot and cold water, roof and overflow drain sump bodies and rain leaders, horizontal sanitary and drain piping which receives condensate.

1.2 QUALITY ASSURANCE

A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.

B. An approved contractor for this work under this Division shall be:
   1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
   2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their owners satisfactorily for not less than 3 years.

C. All piping insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.

D. Condensation on any insulated piping system is not acceptable.

E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.

1.3 APPROVALS

A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.

B. Make a field application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Glass fiber pipe insulation:
   1. Johns-Manville Micro-Lok AP-T.

2. Owens-Corning ASJ/SSL.
3. Knauf ASJ/SSL.

B. Cellular Glass Insulation (Foamglass):
1. Pittsburg Corning.
2. Cell-U-Foam.

C. Fiberglass reinforcing cloth mesh:
1. Perma Glass Mesh.
2. Alpha Glass Mesh.
3. Childers Chil-Glas.
4. Vimasco.

D. Mastics and Adhesives
1. Childers.
2. Foster.
3. Vimasco.
4. Armstrong 520 Adhesive.

E. Elastomeric Insulation
1. Armacell.

2.2 FIBERGLASS PIPE INSULATION

A. Heavy density, dual temperature fiberglass insulation with factory applied, all service, reinforced vapor barrier jacket having integral laminated vapor barrier. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Supply in thickness as shown.
1. Thermal conductivity 0.23 @ 75°F mean (ASTM 335).

2.3 ELASTOMERIC INSULATION

A. Insulation material shall be flexible, closed-cell elastomeric insulation in tubular or sheet form. Material shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, latest revision. Sheet material with a thickness greater than ¾" shall have a flame spread rating of 25 or less and a smoke developed rating of 100 or less when tested in accordance with ASTM E84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive. In addition, all materials shall pass simulated end-use fire test. Minimum ¾" thick.
1. Thermal conductivity 0.27 at 75°F mean (ASTM C177 or C518).

2.4 CELLULAR GLASS INSULATION

A. ASTM C552:
1. "k" value of 0.35 @ 75°F ("ksi" value of 0.047 @ 24°C);
2. 8.0 lb./cu.ft. (128 kg/cu.m.) density.

2.5 INSULATION/SHIELD AT HANGERS

A. Field fabricated: Use 360° sections of rigid foamglass insulation that will support the bearing area at hangers and supports. Further support insulation at hangers and supports with a shield of galvanized metal covering at least half of the pipe circumference, and conforming to the schedule. Insulation shall extend at least 1" beyond metal shield on each end. When pipe is guided at top and bottom, metal shields shall cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide with respect to insulation with ½"

aluminum bands (2) per shield.

1. Sections of foam glass insulation may be used of the same outside diameter of the adjoining pipe insulation.
2. Minimum thickness of foam glass insulation shall not be less than 1” thick.

B. Pipe saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter or more than 22”. Provide 18 gauge through 4” pipe and 16-gauge 5” pipe and above.

2.6 SEALANT, ADHESIVE AND FINISH

A. Lap Adhesive. Provide Childers CP-82 adhesive.

B. Vapor Barrier Finish:
1. Indoors: Provide as insulation coating Childers CP-35, white.
2. Outdoors: Provide as insulation coating Childers Encacel X.
3. Underground: Provide Childers CP-22/24 for fittings and areas. Pittwrap cannot be used.

C. Sealant. Provide Childers CP-76 vapor barrier sealant.

D. Lagging Adhesive. Provide Childers CP-50.

E. Other products of equal quality will be acceptable only upon approval.

PART 3 - EXECUTION

3.1 INTERIOR PIPING

A. Cover all piping with glass fiber, heavy density, dual temperature pipe insulation with a vapor barrier jacket. Apply insulation to clean, dry pipes. Longitudinal seams shall be joined firmly together and sealed with self-sealing lap joints. Butt insulation joints firmly together and seal with a 3” wide ASJ butt strip seal. Longitudinal seams and butt strip laps shall be coated and sealed with CP-35 vapor barrier coating for chilled water piping applications.

B. Install hanger with protective shield, on the outside of all insulation.

C. Where domestic water pipes (1/2” & ¾” pipe sizes) are installed on trapeze type hangers, provide galvanized sheet metal protection shields at these locations. Place insulation jacket directly on hanger. Incompressible, load bearing insulation segments are not required.

D. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter. Provide 18-gauge through 4” pipe and 16-gauge for 5” pipe and above.

E. Seal ends of pipe for drinking chilled water insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe making a complete seal.

F. Apply a smooth flood coat of white lagging Foster 8142W over all exposed insulation.

G. Piping to be insulated as specified above:
1. All hot and cold water.
2. Make-up water

3. Horizontal sanitary drain piping that receives condensate
4. Exposed to view storm drainage system including roof and overflow drain bodies, vertical piping from drain body and all horizontal rain leaders to first elbow turning down

3.2 FLANGE, VALVE AND FITTING INSULATION

A. Cover valves and flanges with fabricated segments, fittings with two-piece factory molded fittings, and both of matching pipe insulation type and thickness equal to that of the adjoining pipe. Fittings and fabricated segments shall be securely held in place.
1. Apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.
2. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
3. Overlap mastic and fiberglass cloth by 2” on adjoining sections of pipe insulation.
4. Apply a second coat of mastic over the fiberglass cloth to present a smooth surface.
5. Apply mastic to a wet film thickness of 3/64”.
6. Fabric shall not be visible after completion.
7. Vapor seal flanges, valves and fittings with Childers CP-35.

B. PVC fitting covers are acceptable.

3.3 CONCEALED STORM DRAIN PIPING

A. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrim-Kraft (FSK) facing. Install insulation on clean, dry piping.

B. Insulation shall be wrapped tightly on the piping with all circumferential joints and longitudinal joints overlapped a minimum of 2” with facing to the outside to obtain specified R-value using a maximum of 25% compression.

C. Provide vapor retarder at penetrations, joints, seams and damage to the facing with staples and FSK foil tape. The facing shall be taped with a minimum 3” wide strip of reinforced foil tape. Pressure-sensitive tape shall be a minimum 3” (76mm) wide and shall be applied with moving pressure using an appropriate sealing tool. Staples shall be outward cinch and placed 6” (152mm) on center.

3.4 MISCELLANEOUS

A. Install materials after piping has been tested and approved.

B. Apply insulation on clean, dry surfaces only.

3.5 INSULATION THICKNESS

INSULATED UNIT	THICKNESS (Inches)
Roof Drain Bodies and Horizontal Roof Drain Leaders	1
Roof Overflow Drain Bodies and Horizontal Drain Leaders	1
Domestic Cold Water.	1
Horizontal Sanitary Drain Piping Which Receives Condensate	1
Domestic Hot Water Piping, 1-1/4” Pipe and Smaller	1
Domestic Hot Water Piping, 1 1/2” Pipe and Larger	1-1/2

END OF SECTION

SECTION 22 08 00

PLUMBING COMMISSIONING COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section outlines commissioning requirements and activities of Contractor, Owner, CxA and Design Professionals as related to the Division 22 Plumbing.

B. Related Sections:
1. Division 01 – General Requirements.
2. Division 22 – Plumbing.
3. Division 23 – Mechanical.
4. Division 26 – Electrical .

1.2 DEFINITIONS

A. Refer to Division 01 – General Requirements.

1.3 CONTACT INFORMATION

A. The Owner will contract directly for commissioning services.
1. Commissioning Agent fee will be paid for directly by the owner.
2. Cost of contractor coordination with the CxA is specified in this section.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Contractor shall provide all standard and specialized testing equipment required to perform Start-up and Functional Performance Testing. Test equipment required for Functional Performance Testing is listed below. Data logging equipment and software required to test equipment shall be provided by the Contractor.

B. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 1.0ºF and a resolution of + or - 0.2ºF). Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and following any repairs to the equipment. Calibration tags shall be affixed or certificates readily available.

2.2 OTHER CONTRACTOR PROVIDED EQUIPMENT:

A. Ladders and/or lifts and appropriate fall protection as required by Contractor site requirements.

PART 3 - EXECUTION

3.1 COORDINATION - GENERAL

A. Except for the activities to be performed by the CxA called for herein, all component and system installation work required by the Division 22, 23 and 26 specifications including

specific contractor furnished items indicated by this Section shall be provided by the Contractor.

3.2 SUBMITTALS

A. Plumbing
1. Plumbing Equipment.

3.3 EQUIPMENT START-UP

A. Notification
1. Contractor shall provide ten Owner business days' notice to CxA, Owner and Design Team of start-up dates.

B. Prior to start-up, contractor shall:
1. Verify that equipment and systems are complete, accessible, correctly connected to utilities and ready for operation. Perform all pre-start inspections and tests as called for in Division 22.
2. Comply with pre-start requirements of manufacturer and complete applicable documentation.
3. Complete applicable sections of Pre-functional Checklists.
4. Coordinate start-up attendance by manufacturer or authorized representative as required by specifications or manufacturer.

C. At start-up, contractor shall:
1. Supervise the activities of the authorized start-up technician or manufacturer's representative.
2. Verify proper voltage, phase, drive rotation and any other conditions that may cause damage if not correct.
3. Execute start-up under supervision of qualified contractor and equipment manufacturer personnel and in accordance with the manufacturer's instruction.
4. Complete manufacturer start-up requirements and documentation. Provide a copy of documentation to the CxA for inclusion in the Cx Manual.
5. Complete PFC's and provide documentation to CxA.
6. Provide documentation of any issues noted during start-up to CxA, Owner and Design Team. Outline recommendations for corrective action.

3.4 FUNCTIONAL CHECKLISTS and TESTING

A. Contractor shall forward completed copies of PFC's to the CxA for inclusion into the Cx documentation. PFC's will be provided by the CxA. As an alternate, contractor shall submit their versions of the PFC's to the CxA for review and comment.

B. Contractor shall complete check list and testing for each of the following equipment:
1. Plumbing:
a. Domestic Hot Water Heaters.
b. Mixing Valves.
c. Trap Primers.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install domestic hot and cold water piping.

1.2 RELATED WORK

A. Division 22 Plumbing
1. Valves, Strainers and Vents.
2. Pipe and Pipe Fittings – General.
3. Plumbing Piping Insulation.
4. Plumbing Fixtures and Fixture Carriers.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Below Slab on Grade Piping for Water Entries:
1. 2-inch and smaller, provide ASTM B88 Type K (heavy wall) annealed tempered (soft) seamless copper water tube. No joints below slab entries.
2. 2 inch and larger, provide one-piece stainless steel IBR (in building riser), Watts or Ames.

B. Below Slab on Grade Piping. Furnish ASTM B 88 and ANSI/NSF Standard 61 annealed tempered (soft), Type K copper water tube. Run continuous with no joints under the floor slab. Provide copper pipe corrosion protection as specified in this Section.

C. Below Slab on Grade Piping: PEX tubing. Refer to section 22 11 21.

D. Above Slab Piping. Provide seamless ASTM B 88 and ANSI/NSF Standard 61 drawn tempered (hard) Type L copper water tube with wrought copper or bronze fittings with solder-joints, ANSI B16.22. Solder material shall be 95-5 (lead free) (Tin-Antimony-Grade 95TA) ASTM B 32.

E. Above Slab Piping: PEX tubing. Refer to section 22 11 21.

F. Unions. Provide 150 lb. standard unions with ground joint and bronze seat. Flange joints larger than 2 inches. Provide dielectric isolating unions at junctions or connection between metallic piping of dissimilar metal. Provide pipe threads with standard taper pipe threads ANSI B2.1.

G. Alternate Method of Joining Copper Pipe and Tubing: Press Fittings: Copper press fitting shall conform to the material and sizing requirements of ASME B16.51. O-rings for copper press fittings shall be EPDM. VIEGA or equal. The system intended for use shall be approved by submittal. Systems from various manufacturers may vary in technology. The field personnel shall carry training credentials from the approved manufacturer for the project. Mixing of fittings from different manufacturers is strictly prohibited.

2.2 WATER HAMMER ARRESTORS

A. Provide piston type hydraulic engineered/manufactured water hammer arrestors in cold and hot water supply lines in chases or walls to each fixture branch or battery of fixtures serving quick closing valves of electrical, pneumatic, spring loaded type, or quick hand closure valves on fixture trim. Provide water hammer arrestors at the end of the branch line between the last two fixtures served. Provide Precision Plumbing Products, Inc., or equal. Size units according to water hammer arrestor's Standard PDI WH-201; refer to schedule on drawings.

B. Install all water hammer arrestors so as to attain 100% effectiveness according to Plumbing and Drainage Institute PDI-WH201 Table 5, 6 and 6-A for water hammer arrestors.

C. All water hammer arrestors shall be installed in a vertical position.

D. Refer to sizing and placement data as indicated in PDI Standard PDI-WH-201.

PART 3 - EXECUTION

3.1 DRAINAGE

A. Install water piping systems with uniform horizontal grade of 1/8 inch per 10 foot, minimum, to low points to provide complete system drainage. Where constant pitch cannot be maintained for long runs, establish intermediate low points and rise to new level. Grade branches to drain to mains or risers. Unless otherwise indicated, terminate low points of risers with drain valve piped to nearest hub or floor drain.

3.2 STERILIZATION

A. Prior to starting work, verify system is complete, flushed and clean.

B. Disinfect water distribution system as required per state and local codes.

C. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651, AWWA C652 or local authority having jurisdiction
   1. Obtain a minimum of one water sample flushing from at least 10% of the outlets and from the water entry.
   2. Take samples from faucets located at highest point in the building, and farthest point from the main water supply.

D. After final flushing, remove aerators, clean and replace.

3.3 TESTING

A. Test under a cold water hydrostatic pressure not less than operating pressure of system and carefully check for leaks. Test shall conform to requirements of IPC and local codes.
   a. Repair leaks and retest system until proven watertight.

B. Test the domestic water piping system at system operating pressure, maintained for minimum of 15 minutes.

C. Use only potable water for the test.

D. Perform the test before fixtures, faucets, trim or final connections are made to equipment.

E. If the system is tested in sections, the entire domestic water piping system shall be submitted

to a final test, employing the specified procedure.

F. Do not insulate or conceal piping systems until tests are satisfactorily complete.

G. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.

H. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

END OF SECTION

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SECTION 22 11 21

PEX PIPE AND FITTINGS
Uponor (Pipe Sizes ½" Through 3" Copper Tube Sizes)

PART 1 – GENERAL

1.1 PIPE

A. All hot and cold water PEX piping shall be manufactured by Uponor North America as AquaPEX or equal and manufactured in a Standard Dimensional Ratio of 9 (SDR 9) and satisfy ASTM F876. As recognized in IAPMO Research and Testing File No. 3558, the tubing is produced from a cross-linked polyethylene compound complying with ASTM F877, has a 100 PSI pressure rating at 180 degrees.

1.2 TECHNICAL DATA

A. APPLICABLE STANDARDS
1. AquaPEX is available in nominal sizes of ¼" through 3" diameter.
2. Uncoated (natural) AquaPEX has a material designation of PEX 5106.
3. Coated (blue and Red) AquaPEX has a material designation of PEX 5206.
4. AquaPEX is recognized as conforming to ASTM F 877 by IAPMO R&T #3558, as well as conforming to NSF 61, NSF (J-00103652).

B. APPLICABLE CODES
1. 2018 International Plumbing Code (IPC).

1.3 FITTINGS

A. Uponor ProPEX® or equal.
1. Third-party certified to NSF 14 and ASTM F1960 cold expansion with PEX reinforcing ring and shall comply with ASTM F876 and ASTM F877, ½ inch through 3 inch nominal pipe size fittings manufactured from the following material types:
a. Reinforcing cold expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960".
2. Uponor multiport tees and elbows: Multiple-outlet fitting complying with ASTM F877 (CAN/CSA B137.5); with ASTM F1960 inlets and outlets.
3. Uponor manifolds Multiple outlet assembly with ASTM F1960 outlets.
a. Type L copper branch manifold with lead-free brass valve outlets.
b. Type L copper branch manifold without valves, with lead-free brass outlets.

B. PEX-to-metal transition fittings:
1. Manufacturers: Provide fittings from the same manufacturer of the piping.
2. Third-party certified to NSF 14 and ASTM F1960 cold expansion with PEX reinforcing ring and shall comply with ASTM F876 and ASTM F877, 1/2 inch through 3 inch nominal pipe size fittings manufactured from the following material types:
a. PEX-a to thread transition: One-piece lead free (LF) brass fitting with male or female threaded adapter and ASTM F1960 cold expansion end, with PEX-a reinforcing cold-expansion ring.
b. PEX-a to copper sweat transition: One-piece lead free (LF) brass fitting with sweat adapter and ASTM F1960 cold expansion end, with PEX-a reinforcing cold expansion ring.

c. PEX-a to copper press transition: One-piece lead free (LF) brass fitting with one ASME B16.51 copper press end and one ASTM F1960 cold expansion end, with PEX-a reinforcing cold expansion ring.
d. PEX-a to flange transition: Tow-piece fitting with one steel flange conforming to ASME B16.5 and one lead free (LF) brass adapter conforming to ASTM F1960.
e. PEX-a to groove transition: One-piece lead free (LF) brass fitting with one CSA B242-05 groove end in either iron pipe size (IPS) or copper tube size (CTS) and one ASTM F1960 cold expansion end with PEX-a reinforcing cold expansion ring.
f. PEX-a to water meter transition: Two-piece fitting with one NPSM union thread and one ASTM F1960 cold expansion end, with PEX-a reinforcing cold expansion ring.

1.4 BASIC USE

A. Uponor's AquaPEX or equal, cross-linked polyethylene (PEX) tubing and fittings for use in potable hot and cold water distribution, water service in buildings of any type of construction allowed under the applicable code.

PART 2 – PRODUCTS

2.1 MATERIALS

A. The piping systems shall be constructed from a cross-linked polyethylene (PEX) tubing and fittings compounds.

2.2 MANUFACTURERS

A. PIPE AND/OR FITTINGS
1. Uponor North America.
2. Or equal.

2.3 SYSTEM DESIGN

A. System design shall be in accordance with standard industry practice for water distribution systems and the manufacturer's instructions. The design shall take into consideration such factors as pressure and flow requirements, friction loss, operating temperatures, support spacing, joining methods, and thermal expansion and contraction.

B. A Hazen-Williams C Factor of 150 shall be used in all hydraulic calculations.

C. AquaPEX:
1. PEX-a (Engel-method crosslinked polyethylene), ASTM F876 and F877 (CAN/CSA-B137.5), SDR 9, CTS, ½ inch through 3 inch nominal pipe size.
2. Tubing is certified to NSF Standards 14 and 61 and listed by the Hydrostatic Stress Board of PPI at 200 degrees F. at 80 PSI, 180 degrees F. at 100PSI and 73.4 degrees F. at 160 PSI.
3. Tubing sizes 2-inch, 2-1/2-inch and 3-inch reach out to manufacturer's representative for proper design flow and velocity sizing of pipe.

PART 3 – EXECUTION

3.1 INSTALLATION PROCEDURES

A. Installation practices such as pipe support spacing, bracing, allowance for thermal expansion/contraction, handling and storage shall be in accordance with the manufacturer's instructions and this specification.

B. Special requirements for PEX pressure pipe and fittings:
   1. Installing contractor shall have successfully completed the Uponor Commercial Piping Systems Training Course (previously AquaPEX Certification) as given by an Uponor employee or Uponor Manufacturer's Representative.
   2. Special installation requirements as indicated above for all PEX pipe systems.

C. Installers must be factory trained. The manufacturer's published installation instructions must be available on the job site if requested by Code officials.

D. Reference the use of Table 6-6 by manufacturer for sizing PEX-a F 1960 domestic water systems.
   1. Reference the use of Uponor Pressure Loss charts for sizing PEX-a domestic water systems that fall outside of Table 6-6 parameters.
   2. Refer to Uponor Plumbing Installation Manual for PEX pipe installation instructions with and without PEX pipe support to ensure proper support and clamping requirements.

3.2 WATER SERVICE AND WATER DISTRIBUTION

A. When installing pipe horizontally it must be laid or supported in a manner that assures the temperature expansion and contraction joints are securely accommodated for. The installation must comply with applicable codes and the manufacturer's published installation instructions.

3.3 LIMITATIONS

A. Pipe and fittings are intended for use at a maximum working pressure of 130 psi at 120°F

B. When installation is in fire resistive assemblies, evidence of compliance with IBC Section 713 (penetrations), UBC Section 709 (walls and partitions), and UBC Section 710 (floor / ceiling or roof / ceiling) and, as applicable, must be provided to the Code official for approval.

C. The tubing and fittings must be protected from exposure to direct sunlight as noted in the manufacturer's installation instructions.

D. Clearances from heat producing equipment must be in accordance with Section 802.10-5 of the IAPMO UMC, Section 503.10.5 of the 2009 International Fuel Gas Code® , Section M1306 of the IRC, and Section 304.6 of the 1997 UMC or, as applicable. In areas enforcing the Uniform codes PEX shall not be installed within 18 inches of a water heater.

E. The tubing must be maintained at the proposed operating pressure during placement of concrete, or prior to backfilling when used in buried applications.

F. Minimum bending radius is six times the outside tube diameter of the PEX tube. The outside diameter is the nominal diameter plus 1/8 inch (3.2 mm) or copper tube size (CTS).

G. Installation of tubing must be pressure-tested in the presence of the building official for any possible leaks.

H. The tubing must not be utilized as a source of electrical ground.

I. The products are produced under a quality control program in Apple Valley, Minnesota with inspection by IAPMO Uniform ES.

3.4 TESTING

A. Test under a cold water hydrostatic pressure of operating pressure and carefully check for leaks. Repair leaks and retest system until proven watertight.

B. Test the domestic water piping system at system operating hydrostatic pressure, maintained for 6 hours.

C. Use only potable water for the test. Do not use compressed air.

D. Perform the test before fixtures, faucets, trim or final connections are made to equipment.

E. If the system is tested in sections, the entire domestic water piping system shall be submitted to a final test, employing the specified procedure.

F. Do not insulate or conceal piping systems until tests are satisfactorily complete.

G. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.

H. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.5 WARRANTY

A. Consult the manufacturer for specific 25 Year System Warranty information.

END OF SECTION

SECTION 22 13 16

SOIL, WASTE AND SANITARY DRAIN PIPING, VENT PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install piping in buildings and underground laterals to 5 foot outside of building.

1.2 RELATED WORK

A. Site Work:
1. Sanitary Sewers.
2. Excavation, Trenching and Backfilling for Utilities.

B. Division 22 Plumbing:
1. Pipe and Pipe Fittings.
2. Plumbing Fixtures and Fixture Carriers.
3. Drains, Cleanouts and Hydrants.
4. Earthwork.

1.3 REFERENCES

A. CISPI - Cast Iron Soil Pipe Institute.

B. ASTM - American Society for Testing and Materials

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cast Iron Soil Pipe and Fittings:
1. AB&I.
2. Charlotte Pipe and Foundry Co.
3. Tyler Pipe / Soil Division.

B. PVC Soil Pipe and Fittings
1. Charlotte Pipe.
2. Westlake Pipe and Fittings.
3. JM Eagle.

2.2 DRAIN PIPE AND FITTINGS

A. Above Slab Piping:
1. Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints.
2. Pipe and fittings shall conform to ASTM D 1784-82.

B. Below Slab on Grade Pipe:
1. Schedule 40 PVC plastic pipe and DWV fittings.
2. Solvent welded DWV joints shall conform to IAPMO Installation Standard IS-9.
3. Pipe and fittings shall conform to ASTM D 1784, ASTM D 1785, ASTM D 2665, ASTM D 3311 and NPS Standard 14 & 61.

2.3 VENT PIPE AND FITTINGS

A. Above Slab Piping. Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82.

B. Below Slab on Grade Piping:
   1. Provide Schedule 40 PVC with DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D1784-82.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All above and below slab soil, waste, sanitary drain and vent piping installation methods shall be in accordance with Cast Iron Soil Pipe Institute Standards.

B. Above ground installation in the horizontal position shall be supported at every hub (hub & spigot or hubless type). Hangers are to be placed within 12” of hub or coupling. For large diameter fittings, 5 inches and larger shall be braced to prevent horizontal movement. Every branch opening or change of direction, braces, blocks, rodding or other suitable method shall be used to prevent movement. Riser clamps to be used for vertical piping, not to exceed 15’-0” between clamps..

C. All above and below slab PVC sanitary waste and vent piping installation methods shall be in accordance with IAPMO Installation Standard 18-9 for Schedule 40 PVC-DWV, per manufacturer’s recommendations and applicable standards.

D. Tracer wires shall be installed on all underground PVC sanitary sewer lines installed outside the building slab.

E. All PVC underground shall be installed in accordance with ASTM D2321.

3.2 GRADE

A. Give horizontal pipe grade of ¼-inch per foot where possible, but not less than 1/8 inch per foot unless otherwise shown.
B. Horizontal below grade 2” waste piping sloped at 1/4 inch per foot.

3.3 DRAIN PIPE AND FITTINGS

A. Offsets and Fittings.
   1. Use reduction fittings to connect two pipes of different diameter.
   2. Change directions by appropriate use of 45-degree wyes, long-sweep quarter-bends, and sixth-, eights-, and sixteenth-bends. Sanitary tees can be used on vertical stacks. Use long sweeps at the base of risers.
   3. Provide a separate trap at each fixture, unless a trap is built into the fixture. Provide a deep seal trap at each floor drain and hub drain. Place traps so that the discharge from any fixture will pass through only one trap before reaching a building drain.
   4. Refer to Sanitary Drainage Code section for acceptable fittings to be used for changes in direction of drainage flow. Double combo sanitary fittings or double wye and 1/8th bend fittings are not allowed for horizontal to horizontal piping systems per Code.

B. Hub Drains. Install hub drains where indicated, with the top of the hub 1/2 above the

finished floor, unless otherwise indicated on the drawings.

C. Cleanouts. Install cleanouts the same size as the soil waste lines in which the cleanouts are placed; however, no cleanout should be larger than 4 inches in diameter. Provide cover with vandal-resistant securing screw.
   1. Where cleanouts occur in pipe chases, bring the cleanouts through the walls and install covers. Where cleanouts occur in floor slabs, set flush. Reference drawing schedule.
   2. Provide cleanouts where soil lines change direction, every 75 foot on long runs, or as shown on the drawings, at the end of each horizontal waste line, and at the base of each riser (and at each increase in pipe size).
   3. Cleanouts shall occur at the end of each battery of water closets, urinals, lavatories, sinks, and single water closets. Cleanouts shall be installed so as to access the main sanitary or soil line. Extend and offset above flood rim of water closet.
   4. Double sanitary tees and double quarter bends do not allow for easy access to main lines, therefore these types of fittings are not allowed.

3.4 VENT PIPING

A. Make vent connections to vent stacks with inverted wye fittings. Extend full-size vents through the roof to at least 12 inches above the roof.

B. Coordinate with roof contractor for installation of vents thru roof. Flashing at vent penetration shall comply with the roofing manufacturer's requirements. Reference the Architectural Drawings for exact requirements.

C. Locate vent piping through roof a minimum horizontal distance of not less than 10 feet from any air intake opening or supply fan.

3.5 TESTING

A. Below Slab on Grade and All Floors in Multi-Story Buildings:
   1. Test pipe below slab on grade before backfilling and connecting to city sewers.
   2. Maintain not less than 10 foot of hydrostatic head for1 hour without a leak.
   3. Before acceptance of the work the contractor must ensure the piping is in working order before and after the slab is poured. To ensure this the contractor must test completed systems in the presence of the Architect, Engineer and authorities having jurisdiction after installation is complete.
   4. Maintain the test on the system till after the slab is poured. Provide an accessible connection that may be reviewed by Architect, Engineer and authorities having jurisdiction prior to and after the slab is poured.
   5. Test drainage piping systems in accordance with governing codes and the requirements specified. Provide equipment and materials and make test connections required to execute tests.
   6. Test drainage and waste piping hydraulically by filling system to its highest point or, whichever is greater, at a static head of 10 feet. Leaks at any joint shall be sufficient cause for rejection.
   7. Air tests may be substituted for hydraulic tests by forcing air into the closed system at a uniform pressure sufficient to balance a column of 10 inch hg in height.
   8. Under any of the previously described tests, the water height shall remain constant, after stabilization, for not less than 15 minutes without any further addition of water.

B. System Test. After the various sections of soil, waste and vent piping are installed, but before fixtures are connected, test the system by:
   1. Plugging outlets.
   2. Filling vertical sections of multiple story buildings of not less than three floors at a time with water. Provide wyes as required to facilitate plugging.
   3. Test for 6 hours without any drop in the water level.

3.6 RODDING SEWERS

A. All sanitary soil and waste lines, both in the building and out, shall be rodded out and flushed out after completion of construction and prior to finish floor being installed. All work must be completed prior to substantial completion. All floor drains and cleanout locations must be included in this work.

B. All sanitary soil and waste lines below building 3” and larger shall be internally videotaped at time of substantial completion. All videotaping shall include on-screen date and time, and include audio narration. All videotaping shall be provided by experienced individual in videotaping piping systems. An Owner’s Representative shall be present during video-taping. Three copies of the videotape shall be delivered to the Owner for future records.

C. This work shall be done in the presence of the Owner’s Representative, as part of the Contract, to ensure all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing the proper rotary head to clear sewer. Pipe sizes 8 inches and larger shall be hydro-flushed.

3.7 SMOKE TESTING

A. Interior Plumbing Piping:
   1. Contractor shall perform smoke testing on all interior sanitary sewer piping and sanitary vent piping above and below floor prior to cover-up.
   2. Artificially created smoke used must be a persistent white tracer smoke and produced by thermogenic chemical reaction. All smoke candles or smoke pencils to be used must be non-toxic and EPA approved. Provided by Superior Signal Smoke Candles.
   3. All plumbing fixtures must be installed including floor drains with wetted trap seals.
   4. Smoke testing shall be performed after completion of any videotaping, rodding or flushing of the sanitary system. Test must be performed prior to ceiling installation in new construction projects. Smoke is usually injected into the building through the two-way cleanout in the main sewer line leaving the building or a plumbing roof vent or fixture. Smoke will travel through the sanitary sewer and vent system and through the air spaces in the sewer lines and emanate from any leaks in the system. The smoke must reach the last roof vent in the system to indicate the entire system has been completely filled with smoke. The smoke must travel the full length of the piping system. Contractor must provide manpower as necessary to visually trace the flow of smoke through the wall cavities, annular floor/ceiling spaces, inject the smoke, observe the roof vents and to identify the integrity problems.
   5. Contractor shall provide a detailed list of findings and a drawing indicating the location, fixture type, type and size of pipe, and or description of type of problems found.
   6. An Owner’s Representative shall be present during smoke testing.

3.8 SMOKE TESTING – LIQUID SMOKE SYSTEM

A. Interior Plumbing Piping:

1. Contractor shall perform smoke testing for finding leaks in all interior of building sanitary sewer piping and sanitary vent piping above and below building slab prior to cover up.
2. Contractor must use a laboratory tested safe liquid smoke with a patented liquid smoke generating system. The liquid smoke must be contained in a pressure tank with inline filter and quick disconnect.
3. Smoke generating system must generate up to 3 hours or more of continuous and constant smoke. Generating system must have a metering valve to precisely control smoke flow and density. Smoke generating system must have a 4” x 6” industrial flexible mining duct for connection to vent stack or cleanout.
4. Smoke generating system must be power full enough to push smoke through the smallest leaks.
5. The liquid smoke must not leave any stains or odors.
6. The liquid smoke shall not contain Zinc Chloride, a listed toxic compound in OSHA 1915,1000 – Air contaminants.
7. Smoke generating system must have a means to atomize the liquid smoke and have an enclosed fan system capable of up to 700 cfm with adjustable inlet damper control to adjust cfm as necessary for the size of system.
8. Provide Hurco “Power smoker “ with Hurco “LiquiSmoke” system or approved equal.
9. All plumbing fixtures must be installed including floor drains with wetted trap seals.
10. Smoke testing shall be performed after completion of any videotaping, rodding or flushing of the sanitary system. Test must be performed prior to ceiling installation in new construction projects. Smoke is usually injected into the building through the two-way cleanout in the main sewer line leaving the building or a plumbing roof vent or fixture. Smoke will travel through the sanitary sewer and vent system and through the air spaces in the sewer lines and emanate from any leaks in the system. The smoke must reach the last roof vent in the system to indicate the entire system has been completely filled with smoke. The smoke must travel the full length of the piping system. Contractor must provide manpower as necessary to visually trace the flow of smoke through the wall cavities, annular floor/ceiling spaces, inject the smoke, observe the roof vents and to identify the integrity problems.
11. Contractor shall provide a detailed list of findings and a drawing indicating the location, fixture type, type and size of pipe, and or description of type of problems found.
12. An Owner’s Representative shall be present during smoke testing.

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SECTION 22 14 13

ROOF DRAINAGE PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install roof drains, drain pipes and accessories.

1.2 RELATED WORK

A. Division 22 Plumbing
   1. Pipe and Pipe Fittings - General; for general piping requirements.
   2. Drains and Cleanouts.
   3. Plumbing Piping Insulation.
   4. Earthwork.

1.3 REFERENCES

A. CISPI – Cast Iron Soil Pipe Institute.
B. ASTM – American Society for Testing and Materials.

PART 2 - PRODUCTS

2.0 ACCEPTABLE MANUFACTURERS

A. Cast Iron Soil Pipe and Fittings
   1. AB&I.
   2. Charlotte Pipe and Foundry Co.
   3. Tyler Pipe / Soil Division.

B. PVC Pipe and Fittings
   1. Charlotte Pipe.
   2. Westlake Pipe and Fittings.
   3. JM Eagle.

2.1 STORM PIPE AND FITTINGS

A. Above Ground Pipe. Provide service weight cast iron Hub and Spigot soil pipe and fittings with compression type neoprene gaskets that conform to ASTM C-564. Pipe and fittings shall meet the requirements of ASTM A 74. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.
   a. Install insulated cast iron storm drain piping serving two roof drains in Boardroom space.

B. Above Ground Piping. Provide Schedule 40 PVC solid core plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 2665.

C. Below Ground Piping: Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82.

D. Provide Fernco “Pro-Flex” shielded couplings, Series 3000 with one-piece neoprene gasket for cast iron pipe transitions to Schedule 40 DWV pipe penetrations through slabs. Sizes 2” through 8” use Series 3000.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All above slab storm piping installation methods shall be in accordance with the Cast Iron Soil Pipe Institute Standards.

B. Above ground installation in the horizontal position shall be supported at every hub (hub & spigot or hubless type). Hangers to be placed within 12” of hub or coupling. For large diameter fittings, 5 inches and larger shall be braced to prevent horizontal movement. Every branch opening or change of direction, braces, blocks, rodding or other suitable method shall be used to prevent movement. Riser clamps to be used for each floor, not to exceed 15’-0”.

C. All above slab and below slab PVC storm piping installation methods shall be in accordance with IAPMO Installation Standard 18-9 for Schedule 40 PVC-DWV, per manufacturer’s recommendations and applicable standards, and in accordance with ASTM D2321.

3.2 GRADE

A. Give horizontal lines minimum grade of 1/8 inch per foot.

3.3 TESTING

A.. Below Slab on Grade.

1. Test pipe below slab on grade before backfilling and connecting to city sewers.
2. Maintain not less than 10 foot of hydrostatic head for 1 hour without a leak.
3. Before acceptance of the work the contractor must ensure the piping is in working order before and after the slab is poured. To ensure this the contractor must test completed systems in the presence of the Architect, Engineer and authorities having jurisdiction after installation is complete.
4. Maintain the test on the system till after the slab is poured. Provide an accessible connection that may be reviewed by Architect, Engineer and authorities having jurisdiction prior to and after the slab is poured.
5. Test drainage piping systems in accordance with governing codes and the requirements specified. Provide equipment and materials and make test connections required to execute tests.
6. Test drainage and waste piping hydraulically by filling system to its highest point or, whichever is greater, at a static head of 10 feet. Leaks at any joint shall be sufficient cause for rejection.
7. Air tests may be substituted for hydraulic tests by forcing air into the closed system at a uniform pressure sufficient to balance a column of 10 inch hg in height.
8. Under any of the previously described tests, the water height shall remain constant, after stabilization, for not less than 15 minutes without any further addition of water.

B. System Test. After the various sections of soil, waste and vent piping are installed, but before fixtures are connected, test the system by:

1. Plugging outlets.
2. Filling vertical sections of multiple story buildings of not less than three floors at a time with water. Provide wyes as required to facilitate plugging.
3. Test for 6 hours without any drop in the water level.

3.4 RODDING SEWERS

A. All storm sewer lines, both in the building and out, shall be rodded out and flushed out

after completion of construction and prior to finish floor being installed. All work must be completed prior to substantial completion. All floor drains and cleanout locations must be included in this work.

B. All storm lines below building 3” and larger shall be internally video-taped at time of substantial completion. An Owner’s Representative shall be present during video-taping. Three copies of the video-tape shall be delivered to the Owner for future records.

C. This work shall be done in the presence of the Owner’s Representative, as part of the Contract, to ensure all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned for pipe sizes up to 6 inches. Pipe sizes 8 inches and larger shall be hydro-flushed.

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SECTION 22 20 00

PLUMBING PIPE AND PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install pipe and pipe fittings for piping systems specified in Division 22 - Plumbing.

1.2 RELATED WORK

A. Division 22 Plumbing
1. Earthwork.
2. Valves, Strainers and Vents.
3. Insulation.
4. Other Piping Sections.

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PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. The particular type of pipe and fittings for each system is specified in the individual sections.

2.2 JOINTS

A. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.

B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions or couplings such as Crane Company #1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.

C. Solder joints.
1. Prior to making joints, cut pipe square and ream to full inside diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
3. Use silver brazing alloy or Sil-Fos on underground water entry piping. Use lead free solder on all other copper piping.

D. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. The use of mitered joints is not approved.

E. No Hub. Hubless joints shall be made with wide body, neoprene sealing sleeve with stainless steel sleeve, coupling joints conforming to ASTM C 1277.
1. 4" pipe size and smaller coupling housing minimum of 3" width; 24 gauge Series 300 stainless steel with hi-torque clamps; neoprene coupling gasket.
2. 6" through 10" pipe size coupling housing minimum of 4" width.
3. Tighten clamps to within manufacturer's tolerances using preset torque wrench.

F. Compression Joints for Cast Iron Water Pipe. Use Beltite, Tyton or Grip-Tite compression joints. Install in accordance with the manufacturer's recommendations for compression joints. Provide adequate concrete thrust blocks at changes of direction, as recommended by the manufacturer.

G. Compression Gasket System. Bell and spigot cast iron pipe 4" and smaller, use flax-base lubricant, Tyler Ty-Seal Lubricant or Charlotte Regular Lubricant. 6" and larger use a neoprene base lubricant, Charlotte Adhesive Lubricant.

H. Ring-Tite Joints: Ring-Tite gasketed sewer fittings for sanitary and storm. Furnish joints for installation manufactured per ASTM/CSA, Ipex, and J.M Eagle C900. Provide adequate concrete thrust blocks at changes in direction, as recommended by manufacturer. JM Eagle pressure rated PVC water pipe. ASTM D2241 pressure rating, ASTM D3219 joints, gaskets ASTM F477.

I. Press fittings for copper pipe 1/2” to 4”: Copper press fittings shall conform to the material and sizing requirements of ASTM B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM. Pro-Press System manufactured by VIEGA. The system intended for use shall be approved by submittal. Systems from various manufacturers may vary in technology. The field personnel shall carry training credentials from the approved manufacturer for the project. Mixing of fittings from different manufacturers is strictly prohibited.

J. Press fittings for steel pipe ½” to 2”: Where accepted by local code for specific applications, Cold Press Mechanical Joint Fittings shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria of ANSI/CSA LC4. Sealing system shall be EPDM or HNBR as appropriate for a defined application. MegaPress system manufactured by VIEGA or approved equal and include “Smart Connect” assurance that unpressed fittings will not hold pressure. The system intended for use shall be approved by submittal. Systems from various manufacturers may vary in technology. The field personnel shall carry training credentials from the approved manufacturer for the project. Mixing of fittings from different manufacturers is strictly prohibited.

2.3 UNIONS

A. Use 150 lb. standard (300 lb. WOG) malleable iron, ground joint unions with bronze seat. Provide flanged joints on piping 2-1/2" and larger.
   1. Where pipe materials of different types join, use a dielectric union. Union shall be threaded, solder or as required for its intended use.

2.4 BRANCH CONNECTIONS

A. Pipe 2" and Smaller. For threaded piping, use straight size reducing tee. When branch is smaller than header, a nipple and reducing coupling or swagged nipple may be used.

B. 2-1/2" through 36": For welding piping, when branch size is the same as header size, use welding tee. Use Weld-o-let when branch is smaller than header. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.

2.5 GASKETS

A. High Temperature Piping. Provide 1/16" thick ring gaskets of aramid reinforced SBR such as Garlock #3200 or 3400 or equal by Advanced Products and Systems.

B. Other Piping. Provide ring rubber gaskets, Garlock #7992 or equal by Advanced Products and Systems. Use 1/8" thick cloth reinforced neoprene gaskets. For smaller than 6", use 1/16" thick gasket.

2.6 FLOORS AND CEILING PLATES

A. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas; size plates to fit pipe or insulation and lock in place.

2.7 DOMESTIC MANUFACTURE

A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America unless specifically named in these specifications.

PART 3 - EXECUTION

3.1 PIPE FABRICATION AND INSTALLATION

A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufactured, for maintenance.

B. Cut all pipes to measurement determined at the site. After cutting pipe, remove burrs by reaming. Bevel plain ends of ferrous pipe.

C. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make changes in direction. Field bending and mitering is prohibited. Make connections to equipment using flanged joints, unions or couplings. Make reducing connections with reducing fittings only.

D. Install piping without tapping out of the bottom of pipe.

E. Press Connections: Copper and steel press fittings ½” through 4” shall be applied in accordance with the manufacturer’s installation instructions. The tubing/pipe shall be fully inserted into the fitting and the tubing/pipe marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing/pipe to assure the tubing/pipe is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer. If soldering (thread adapters, etc.) near press fittings, take precautions to not damage the O-ring fittings. Maintain three pipe diameters or use a cooling agent. Viega-“Pro-Press”.

3.2 WELD

A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping.

B. Align piping and equipment so that no part is offset more than 1/16". Set fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.

C. Do not permit any weld to project within the pipe so as to restrict flows. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.

D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.

E. Remove dirt, scale and other foreign matter from inside piping before tying into existing piping sections, fittings, valves or equipment.

F. Bevel ends of ferrous pipe.

3.3 OFFSETS AND FITTINGS

A. Due to the small scale of drawings, the indication of offsets and fittings is not possible. Investigate the structural and finish conditions affecting the work and take steps required to meet these conditions.

B. Install pipe close to walls, ceilings and columns so pipe will occupy minimum space. Provide proper spacing for insulation coverings, removal of pipe, special clearances, and offsets and fittings.

3.4 SECURING AND SUPPORTING

A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging.

B. Provide supports both sides of elbows for pipe 6" and larger. For smaller pipe provide support within 12” of elbows and tees.

C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed. Provide structural support for piping penetrating chase walls to fixtures. On cold water pipe, supports shall be outside the insulation.

D. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section and are sized in accordance with the schedule on the drawings.

E. Install trapeze hangers, properly sized, to support the intended load without distortion.

F. Use electro-galvanized or zinc plated threaded rods, nuts, washers and hangers.

G. At outdoor locations, all supports, brackets and structural members shall be hot-dipped galvanized.

H. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Copper & Steel Max. Support Spacing, Feet	Cast Iron Max. Support Spacing, Ft.	Minimum Rod Diameter, Inches
1" & smaller	6		3/8
1-1/4" & 1-1/2"	8	5	3/8
2"	10	5	3/8

Pipe Size	Copper & Steel Max. Support Spacing, Feet	Cast Iron Max. Support Spacing, Ft.	Minimum Rod Diameter, Inches
3"	10	5	1/2
4" & 5"	10	5	5/8
6" and above	10	5	3/4

I. PEX Piping:
   a. Maximum hanger spacing, 2'-8".
   b. Hanger rod diameter, 3/8 inch.
   c. Hanger spacing per piping manufacturer's instructions when using horizontal rigid metal channel to support piping.

3.5 PIPE SUPPORTS

A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanize members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.

B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. Provide adjustable clevis with a nut / washer above and below the hanger on the support rod. Ring type clevis hangers are not acceptable.

C. Provide Anvil Figure 45 galvanized or primed and painted channel assembly for trapeze hangers.

3.6 PIPE SUPPORTS ON ROOF

A. Support gas pipe on roof with Miro Industries Model 3-RAH-8 or approved equal with roller and fully adjustable height throughout pipe run. Base material shall be high density / high impact polypropylene with UV inhibitors and anti-oxidants. Provide with hot dip galvanized rod finish and framing. Nuts and washers shall be hot dip galvanized.

3.7 ANCHORS

A. Provide anchors as required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe. When possible, install sleeves in structural concrete prior to pouring of concrete.

3.8 FLOOR PENETRATIONS

A. At locations where pipe passes through floors, provide watertight concrete curb around penetration.

3.9 PIPE SLEEVES

A. Sleeves through masonry and concrete construction:
   1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
   2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.

B. Sleeves through gypsum wall construction.
   1. Fabricate sleeves of 16 gauge galvanized sheet metal.

C. Sleeves through elevated slab construction.
   1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.

D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2” above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.

E. Caulk sleeves water and air tight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.

F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.

G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.

H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.10 ISOLATION VALVES

A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for equipment, to isolate central plant, and at other locations.

3.11 DRAIN VALVES

A. Install drain valves at low points of water piping systems so that these systems can be entirely drained. Install a line size drain valve for pipes smaller than 2" unless indicated otherwise. For pipes 2-1/2" and larger, provide 2" drain valves unless indicated otherwise. Drain valves shall be plugged when not in use and at completion.

3.12 CLEANING OF PIPING SYSTEMS

A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge and circulate.

B. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow down ball valve and pipe to nearest drain. Blow down strainers, remove and clean as frequently as necessary.

C. Phase One: Initial flushing of system. Remove loose dirt, mill scale, weld beads, rust and other deleterious substances without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until

"potable water clear" and particles larger than 5 microns are removed.

D. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.

E. Dispose of water in approved manner.

F. Phase Two: Cleaning of Piping Systems. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), soldering flux, mill varnish, piping compounds, rust (iron oxide) and other deleterious substances not removed by initial flushing. Flush system and replace with clean water.

G. Phase Three: Final flushing and rinsing: Flush and rinse until "potable water clear" and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.

H. Submit status reports upon completion of each phase of work on each system.

3.13 TESTING

A. Test piping after installation with water hydrostatic pressure equal to or greater than system operating pressure and carefully check for leaks. Repair leaks and retest system until proven watertight.

B. Do not insulate or conceal piping systems until tests are satisfactorily complete.

C. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.

D. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.14 PIPE MARKERS

A. Identify interior piping with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers or equal, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.

B. Install identification in the following locations:
1. Both sides of penetrations through walls, floors and ceilings.
2. Close to valves or flanges.
3. Intervals on straight pipe runs not to exceed 50 feet
4. Apply marker where view is obstructed.

D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 "Scheme for Identification of Piping Systems".

END OF SECTION

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SECTION 22 33 13

TANKLESS ELECTRIC WATER HEATER

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Tankless electric water heaters for domestic water systems.

1.2 RELATED WORK

A. Division 22 Plumbing
   1. Domestic Water Piping.
   2. Plumbing Piping Insulation.
   3. Division 26 Electrical.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Chronomite.
B. EEMAX.
C. Approved equal.

2.2 PRODUCTS

A. Factory-assembled and wired, electric, Tankless water heater with digital microprocessing temperature control, replaceable cartridge element, replaceable water inlet filter. flow switch activated heater.
B. Hot water temperature range of 103°F to 120°F.
C. 0.30 GPM flow rate activation.
D. Low pressure model if required. Contractor shall verify pressure at site.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
B. Engage a factory-authorized service representative to inspect components, assemblies and equipment installations, including connections, and to assist in testing.
C. Mount water heaters on wall or in cabinets in accessible location. Adjust and level equipment.
D. Coordinate power with electrical contractor.

3.2 WARRANTY

A. Provide standard manufacturer’s 1 year commercial warranty for mechanical and electrical and 5 year warranty for leaks. Warranty shall start the date of the substantial completion certificate.

END OF SECTION

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SECTION 22 33 34

ELECTRIC WATER HEATER (Commercial - Non-ASME)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Electric water heaters for domestic water systems.

1.2 RELATED WORK

A. Division 22 Plumbing
   1. Domestic Water Piping.
   2. Plumbing Piping Insulation.
   3. Division 26 Electrical.

1.3 WARRANTY

A. Provide standard manufacturer's 1 year commercial warranty for mechanical and electrical and 5 year warranty for leaks. Warranty shall start the date of the substantial completion certificate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. A. O. Smith.

B. Bradford White.

C. Rheem/Ruud.

2.2 PRODUCTS

A. Provide electric water heaters with kilowatt, recovery ratings, and storage capacities as scheduled on drawings.

B. Provide a tank designed for 150 psig working pressure. Furnish glass-lined tank. Lining shall be corrosion-resistant.

C. Furnish factory-assembled, integral units equipped as follows:
   1. Extruded high density anode rod.
   2. Individually mounted thermostat at each element with a high temperature cutoff.
   3. High temperature limit switch (energy cutout).
   4. UL rated.
   5. Temperature and pressure relief valve.

D. Provide medium watt density elements having zinc-plated copper sheathing and prewired leads.

E. The outer jacket shall be baked enamel finish and shall be provided with full size control compartment for performance of service and maintenance through hinged front panels and shall enclose the tank with foam insulation.

F. Electrical junction box with heavy duty terminal block shall be provided.

G. Heater shall have a three year limited warranty.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installations shall be in accordance with the manufacturer's published recommendations.

C. Furnish all supports required by the equipment included in this Contract.

D. Provide a wall support platform beneath heaters with integral drain pan.

E. Furnish and install all necessary valves, traps, gauges, strainers, unions, etc. to facilitate proper functioning and servicing of equipment.
   1. Install a line size shutoff valve in cold water inlet and hot water outlet close to each heater.
   2. Provide a temperature gauge in the domestic hot water piping within five feet of outlet to each heater, upstream of all shut-off valves. Size and locate gauges to be easily readable from a standing position.

F. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment, such as dielectric coupling or dielectric flange fitting.

G. Pipe relief valve discharge and all equipment drains indirectly to appropriate floor drain.

H. Set thermostats on domestic water heaters to delivery maximum water temperature as indicated on Contract Drawings. Set the operating and safety controls.

I. Furnish and install an expansion tank on cold water supply to heater. Locate tank as close to water heater as possible between water heater and all check valves or backflow preventers. Expansion tank capacity shall be as scheduled on Contract Drawings. Install expansion tank in accordance with manufacturer's recommendations.

3.2 STARTUP

A. Startup shall be performed by factory trained and authorized personnel. The factory representative shall also provide a technical and practical operation and maintenance training seminar including a hands-on operation and maintenance demonstration, and classroom presentation with handouts and visual aids, for no less than three physical plant personnel.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES AND FIXTURE CARRIERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install water closets, urinals, lavatories, electric drinking fountains, fixture carriers and plumbing appurtenances.

1.2 RELATED WORK

A. Division 22 Plumbing
   1. Drains, Hydrants and Cleanouts.
   2. Domestic Water Piping.
   3. Soil, Waste and Sanitary Drain Piping and Vent Piping.

1.3 JOB REQUIREMENTS

A. Furnish plumbing fixtures and trim as shown and specified. Provide faucets, fittings, supply stops and similar devices of a single manufacturer. Furnish faucets and supply stops with renewable seats. Porcelain to steel and enameled cast iron fixtures shall be acid resistant. Wall hung fixtures shall be installed with a fixture carrier.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Plumbing Fixtures (Vitreous China):
   1. American Standard.
   2. Kohler.

B. Plumbing Faucets:
   1. American Standard.
   2. Chicago Faucets.
   3. Moen Commercial.

C. Supports and Carriers:
   1. Wade.
   2. Zurn.
   3. J.R. Smith.
   4. Watts.
   5. MIFAB.

D. Flush Valves:
   1. Sloan.

E. Supplies, Stops and Chrome Plated Tubular Brass:
   1. McGuire.
   2. Brasscraft.
   3. ProFlo.

F. Water Closet Seats:
   1. American Standard.
   2. Bemis.

3. Kohler.

G. Floor Drains, Floor Sinks & Roof Drains:
1. Zurn.
2. J.R. Smith.
3. Sioux Chief.

H. Cleanouts:
1. J.R. Smith.
2. Zurn.
3. Sioux Chief.

I. Mop Sinks:
1. Fiat.
2. Stern Williams.
3. Acorn.

J. Stainless Steel Sinks:
1. Elkay.
2. ProFlo.
3. Just.

K. Water Hammer Arrestors:
1. Precision Plumbing Products.
2. Sioux Chief.
3. Watts.

L. Thermostatic Mixing Valves
1. Watts.
2. Caleffi.
3. Symmons.

M. Wall Hydrants:
1. Woodford.
2. JR Smith.
3. Wade

N. Trap Primers:
1. Sioux Chief.
2. Precision Plumbing Products
3. MiFab

O. Electric Water Cooler
1. Elkay
2. Oasis.

2.2 REQUIREMENTS

A. Refer to the drawings for equipment to be supplied.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the manufacturer's instructions. Set level and plumb. Secure in place to counters, floors and walls providing solid bearing and secure mounting.

Bolt fixture carriers to floor and wall. Secure rough-in fixture piping to prevent movement of exposed piping. Cover exposed water closet bolts with bolt covers.

B. Make rough-in and final connection of service to each fixture provided under this Section and other Sections, Equipment furnished by others, Architectural and Plumbing Drawings.

C. Provide necessary stops, valves, traps, unions, vents, cold water, hot water, sanitary, etc. for a complete installation. Provide chrome plated rigid or stainless steel flexible supplies to fixtures with commercial grade quarter-turn loose key or removable handle stops, reducers, and escutcheons. Install fixture stops in readily accessible location for servicing.

D. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibbs, and where shown on drawings. Piping stub outs for supply stops shall be type L copper.

E. Remove piping and services roughed-in incorrectly and install correctly, without cost.

F. Exposed piping, fittings and appurtenances shall be chrome-plated brass. Cover pipe penetrations with escutcheons. Exposed traps, stops, piping and escutcheons to be chrome plated brass and incased with ADA compliant covers.

G. Coordinate with the Equipment suppliers for locations and service required for equipment furnished or provided by others.

H. All floor drains and floor sinks shall have a trap primer connection for trap seal protection.

I. All floor drains and floor sink locations are to be coordinated with all equipment. Locate drains in mechanical equipment spaces to conform to drain locations of equipment furnished. Coordinate drain location with equipment and Architectural Drawings.

J. All floor drains and cleanout covers are to be provided with stainless steel vandal resistant screws.

K. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

L. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components. Adjust valves for intended water flow rate to fixtures without splashing, noise or overflow.

M. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

N. Clean plumbing fixtures and equipment. Do not permit use of fixtures by construction personnel.

O. Protect installed products from damage due to subsequent construction operations.

P. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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SECTION 22 63 11

GAS PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install steel gas pipe inside buildings and on roof, including the supply line from the meter, service lines to gas equipment and appliances, termination of the service line with a plug valve, drip leg, pressure regulator and final connection to equipment and appliances with unions.

B. Coordinate with Gas Company for gas meter capacity to handle increase in gas load.

C. Extend steel gas piping from meter to inside the building and on roof to all fixtures, appliances and equipment requiring gas.

1.2 RELATED WORK

A. Division 22 Plumbing
1. Plumbing Pipe and Fittings.
2. Valves and Vents.

1.3 UTILITY CONNECTIONS

A. Make arrangements for and pay all fees and connection charges for obtaining service to the building.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS - ABOVE GRADE

A. Pipe 2 inch and Smaller:
1. Schedule 40 ASTM A 53 black steel pipe.
2. Factory fabricated socket weld fittings or threaded. NFPA 54, ASME B31.1.
3. Where approved for a specific project and where accepted by local code, cold press mechanical joint fittings shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria of ANSI/CSA LC4. Sealing elements shall be HNBR and the fittings shall bear the CSA stamp to confirm acceptability for fuel gas systems. MegaPress system manufactured by VIEGA including “Smart Connect” or approved equal to assure unpressed fittings will not hold pressure. Installers shall carry training credentials from the manufacturer to confirm they have been instructed in the correct installation procedures.

B. Pipe Larger than 2 inch:
1. Schedule 40 ASTM A 53 black steel pipe.
2. Factory fabricated butt weld fittings for welded steel pipes shall conform to ASTM A-234 WPB (seamless weld fittings).

C. Unions:
1. Standard 150 lb. (300 lb. water, oil or gas) malleable iron.
2. Ground joint unions, with bronze seat.
3. Flange joints for pipe larger than 2 inch in diameter.

D. Flanges:
1. Steel flanges. ANSI B16.5 and ASTM A-105.

2.2 PIPE AND FITTINGS - BELOW GRADE OUTSIDE BUILDING

A. Polyethylene pipe shall be ASTM D3350 Grade PE24 cell classification and ASTM D1248 Class B material classification.

B. B. Pipe shall be medium density polyethylene PE 2406 and PE 2708 manufactured by Poly Pipe Industries, Inc. or Performance Pipe.

C. C. Polyethylene yellow molded butt fittings for use with medium density polyethylene pipe shall meet testing requirements of ASTM D2513 and resin material listing of ASTM D3350 with PPI designation of PE 2406 as manufactured by Central Plastics Co or equal.

2.3 VALVES

A. See Section 22 05 23.

2.4 GAS PRESSURE REGULATOR

A. Size the gas pressure regulator in accordance with the manufacturer's recommendations for flow quantities and reduced pressure as required for all equipment. Coordinate final equipment gas pressure requirements prior to ordering regulators. Provide Maxitrol or American Meter Company regulators or approved equal, suitable for indoor or outdoor installation. Regulators outside exposed to weather shall be installed with vent in vertical down position.

B. All line pressure regulators shall be listed in accordance with ANSI (American National Standard) Z21.80 and CSA (Canadian Standards Association Standard) 6.22.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation Standards: Install gas piping in accordance with recommendations of the National Fire Protection Association.

B. Drip Legs: Install a capped drip leg 6 inches long at the base of each vertical rise.

C. Coating and Wrapping. Coat and wrap underground piping in accordance with the service utility company standards.

D. Sleeves.
1. Encase gas piping running in or through solid partitions with thin wall metal conduit. Sleeve piping and fittings shall be two pipe sizes, but not less than 1 inch larger than encased gas piping.

E. Do not install gas piping exposed to view inside public area, or occupied spaces, without prior written approval.

F. Provide test ports and isolation valves to enable proper testing of system in the future.

G. Provide isolation valve and unions across regulators for proper removal.

H. Provide anodeless transition risers where below grade polyethylene pipe changes to steel pipe above grade.

I. Gas Pressure Regulators / Vents:

1. Piping shall be sized in accordance with the regulator manufacturer's instructions. Never use pipe sizes smaller than the vent size; smaller pipe sizes restrict the gas flow. Where there is more than one regulator at a location, each regulator shall have a separate vent to the roof / outdoors or provide vent limiter.
2. Support the vent pipe to eliminate strain on the regulator diaphragm case.
3. Install vent piping from regulators to location to prevent gas smells from entering building. Do not locate the vent line terminus near windows, fans, or other ventilation equipment. See the installation instructions furnished with the regulator.
4. Install double elbows and insect screen at end of piping to prevent moisture and insects from entering. Always point outdoor vent pipes in the downward position to reduce the possibility of rain, snow, sleet, and other moisture entering the pipe.
5. Regulators installed outside or on roof top: Install regulator vent turned downward with insect screen over vent opening. The vent shall be designed to prevent the entry of water, insects, or other foreign materials that could cause blockage.
6. Adhere to all applicable codes and regulations.

3.2 TESTING GAS PIPING

A. Preliminary gas test as required by Code, but minimum test pressure of 3 PSI held for not less than eight hours without noticeable drop.

B. Test joints with a soap solution while lines are under pressure.

C. Repair leaks.

D. Final gas test shall be with a 24 inch column of mercury or a diaphragm gauge with a minimum dial size of 3-1/2 inches with a set hand and a pressure range not to exceed twenty (20) psig with 2/10-pound increments. The minimum test pressure shall not be less than 3 PSI and the maximum test pressure shall be 1.5 times system operating pressure. This test will be observed for no less than (30) thirty minutes with no drop in pressure.

E. Provide copy of gas pressure test reports in Operations & Maintenance Manual.

3.3 IDENTIFICATION CONDUCTOR

A. Spiral A #12 AWG insulated copper conductor the full length of the thermoplastic piping system. Fasten to the pipe at 3 foot intervals with plastic tie wraps.

B. Terminate at each end in a 12 inch x 12 inch x 4 inch FRP junction box.
1. Bolted gasketed cover with stainless steel screws.
2. Screw type terminal strip.
3. Legend on cover "gas pipe identification conductor."

C. Set in concrete pad.

3.4 PAINT EXPOSED OUTSIDE GAS PIPE

A. Interior and Exterior Gas piping shall be protected from rust.

B. Paint pipe with a flat alkyd coating, clean pipe prior to painting by preparing surface by hand tool cleaning per SSPC-SP2-82, applying one coat of Glidden Y-590 Rustmaster Metal Primer White and top coat of Yellow Alkyd Flat Enamel.

END OF SECTION

SECTION 23 05 00

MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 23 Mechanical.

B. Applicable provisions of this section apply to all sections of Division 23, Mechanical.

1.2 CODE REQUIREMENTS AND FEES

A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.

B. Mechanical work shall comply with applicable inspection services:
1. Underwriters Laboratories.
2. National Fire Protection Association.
3. State Health Department.
4. Local Municipal Building Inspection Department.

C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.

D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.

E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:
1. A specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 CONTRACT DRAWINGS

A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of

various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.

B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain 3 sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducibles is a condition of final acceptance. Provide record drawings on one set each (reproducible Dayrex mylar film positives) and AutoCad 2014 files on disk (CD Rom).

C. As-Built drawings should indicate the following information as a minimum:
1. Indicate all addendum changes to documents.
2. Remove Engineer’s seal, name, address and logo from drawings.
3. Mark documents RECORD DRAWINGS.
4. Clearly indicate: DOCUMENT PRODUCED BY.
5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
6. Indicate exact location of all underground mechanical piping and elevation.
7. Indicate exact location of all underground electrical raceways and elevations.
8. Correct schedules to reflect (actual) equipment furnished and manufacturer.
9. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
10. Exact location of all electrical equipment in and outside of the building.
11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
12. Cloud all changes.

1.7 SPACE REQUIREMENTS

A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.

B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.

C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.

D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.

E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

A. Manufacturers names and catalog number specified under sections of Division 23 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the Contract Documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed. Any redesign costs associated with the integration of substitute equipment into the existing Contract Documents, shall be billed by the Architect/Engineers, on an hourly basis, to the substituting contractor. Resulting change orders from the redesign are the sole responsibility of the substituting contractor.

B. Written notification of intent to use manufacturers other than those specified is required ten days prior to bid. Submittals shall be reviewed only after bidding and may be rejected if any aspect of the equivalent product is deemed lesser than that of the specified product by the specifier. The contractor shall be responsible for ensuring alternates are equivalent to those specified. Submit a marked-up set of the relevant specification section indicating all variances, a comparison to the specified product, and of construction and performance criteria, complete design and performance data for the

specified product and the proposed substitution for comparison to the Engineer. The Architect issues approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.

1.14 OPERATING TESTS

A. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 AIR FILTERS AND PIPE STRAINERS

A. Immediately prior to substantial completion of the project, inspect, clean and service air filters and strainers. Replace air filters.

3.3 LUBRICATION, REFRIGERANT AND OIL

A. Provide a complete charge of correct lubricant for each item of equipment requiring lubrication.

B. Provide a complete and working charge of proper refrigerant, free of contaminants, into each refrigerant system. After each system has been in operation long enough to ensure completely balanced conditions, check the charge and modify for proper operation as required.

C. Provide a complete charge of special oil for refrigeration use, suitable for operation with refrigerant, in each system.

3.4 HOUSEKEEPING PADS

A. Provide equipment housekeeping pads under all floor mounted and ground mounted HVAC equipment, and as shown on the drawings.

B. Concrete work as specified in Division 3.

C. Concrete pads:
   1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
   2. Chamfer strips at edges and corner of forms.
   3. Smooth steel trowel finish.
   4. Doweled to existing slab.

D. Install concrete curbs around duct penetrations or multiple pipe penetrations.

3.5 INSTRUCTION OF OWNER'S PERSONNEL

A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
   1. Provide the training during the Owner's regular working day.
   2. The Instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.

B. Time to be allocated for instructions.
   1. Minimum of 4 hours dedicated instructor time.

C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
   1. One copy to the Owner.
   2. One copy to the Architect/Engineer.

D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.

E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.

G. Demonstrate equipment functions (both individually and as part of the total integrated system).

H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.

J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system,

that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.6 EQUIPMENT IDENTIFICATION

A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
   1. Designation approved by Architect/Engineer.
   2. Equipment includes, but is not limited to, air handling units, fan coil units, variable volume boxes, fans, pumps, boilers and chillers.
   3. Submit schedule of equipment to be included and designations.

B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.7 OBSTRUCTIONS

A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
   1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
   2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.8 PROTECTION

A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

3.9 INDOOR AIR QUALITY

A. All equipment and ductwork shall be installed to allow sufficient space for testing, maintenance, and commissioning functions. Access doors or panels shall be installed in ventilation equipment, ductwork, and plenum enclosures for inspection and cleaning of outdoor air intakes, mixing plenums, up and downstream of coils, filters, drain pans and fans.

B. Practice source control and eliminate potential contaminants in material selection, installation, and maintenance.

C. Provide installation and disposal instructions for all materials and chemicals that are potential contaminants.

D. Obtain and conform to the requirements of the Material Safety Data Sheets (MSDSs) in the use of materials.

E. Utilize manufacturer’s recommendations and provide installation instructions for all chemicals, compounds, and potential contaminants including pre-installation degassing if

required.

F. Ventilate completed building prior to final completion using no less than design outside air for at least 48 hours before occupancy.

G. Make provisions for controls to prevent the entry of air contaminants into the HVAC air distribution system.

H. Steps shall be taken to ensure that the HVAC system continues to function effectively and are not damaged or contaminated during construction activities.

END OF SECTION

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SECTION 23 05 12

HVAC SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Prepare submittals as required by these specifications as outlined below.

B. The term submittal, as used herein, refers to all:
1. Shop Drawings.
2. Coordination Drawings.
3. Product data.

C. Submittals shall be prepared and produced for:
1. Distribution as specified.
2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section.

1.2 SHOP DRAWINGS

A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.

B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.

C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.

D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: ¼” = 1’-0”.

B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.

C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
1. Actual mechanical equipment and components to be furnished.
2. Service clearance.
3. Relationship to other equipment and components.
4. Roof drains and leader piping.
5. Fire protection piping and equipment.

D. Identify field dimensions. Show relation to adjacent or critical features of work or products.

E. Related requirements:
   1. Ductwork shop drawings.
   2. Coordination drawing specified in Division 26.

F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.

B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.

C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.

D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: COMPLY, DO NOT COMPLY, or NOT APPLICABLE. Explain all DO NOT COMPLY statements.

F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

A. Review submittals prior to transmittal.

B. Determine and verify:
   1. Field measurements.
   2. Field construction criteria.
   3. Manufacturer's catalog numbers.
   4. Conformance with requirements of Contract Documents.

C. Coordinate submittals with requirements of the work and of the Contract Documents.

D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.

E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or

begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.

F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.

G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.

H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
   1. Proper sizes and capacities.
   2. That the item will fit in the available space in a manner that will allow proper service.
   3. Construction methods, materials and finishes.

I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.

B. Number of submittals required:
   1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
   2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect/Engineer.

C. Accompany submittals with transmittal letter, in duplicate, containing:
   1. Date.
   2. Project title and number.
   3. Contractor's name, address and contact number.
   4. The number of each Shop Drawing, Project Datum and Sample submitted.
   5. Other pertinent data.

D. Submittals shall include:
   1. The date of submission.
   2. The project title and number.
   3. Contract Identification.
   4. The names of:
      a. Contractor.
      b. Subcontractor.
      c. Supplier.
      d. Manufacturer.
   5. Identification of the product.
   6. Field dimensions, clearly identified as such.
   7. Relation to adjacent or critical features of the work or materials.
   8. Applicable standards, such as ASTM or federal specifications numbers.
   9. Identification of deviations from contract documents.
   10. Suitable blank space for General Contractor and Architect/Engineer stamps.
   11. Contractor's signed and dated Stamp of Approval.

E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
   1. Finishes which involve Architect/Engineer selection of colors, textures or patterns.
   2. Associated items which require correlation for efficient function or for installation.

1.8 SUBMITTAL SPECIFICATION INFORMATION

A. Every submittal document shall bear the following information as used in the project manual:
   1. The related specification section number.
   2. The exact specification section title.

B. Submittals delivered to the Architect/Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

A. Make re-submittals under procedures specified for initial submittals.
   1. Indicate that the document or sample is a re-submittal.
   2. Identify changes made since previous submittals.

B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.

B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect/Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.

C. Do not deliver any submittals to the Architect/Engineer that do not bear the Contractor's stamp of approval and signature.

D. Submittals delivered to the Architect/Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

A. The Architect / Engineer will:
   1. Review identified submittals with reasonable promptness and in accordance with schedule.
   2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal.
   3. Return submittals to Contractor for distribution or for resubmission.

B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.

C. Architect / Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
   1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
   2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.

D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

A. Do not make requests for substitution employing the procedures of this Section.

B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

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SECTION 23 05 13

ELECTRICAL PROVISIONS OF HVAC WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Electrical provisions to be provided as mechanical work are indicated in other Division 23 sections, on drawings, and as specified.

B. Types of work, normally recognized as electrical but provided as mechanical, specified or partially specified in this Section, include but are not necessarily limited to the following:
   1. Motors for mechanical equipment.
   2. Starters for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
   3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
   4. Wiring of field-mounted float control switches, flow control switches, and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.
   5. Wiring of smoke detectors for shutdown of air handling equipment when a fire alarm system is not included in the project.
   6. Wiring of oil pump, vibration and oil level limit switches for cooling towers.
   7. Refrigerant monitor/sensor/alarming and field installed visual/audible display alarms.
   8. Pipe heat tracing.
   9. Cooling tower vibration switch/interlock/reset.
   10. Field interlock wiring from chiller: flow switches, pump aux. Contacts, pump start/stop.
   11. Power supply 120 VAC and control signal from chiller control panel to condenser water flow control valve installed in piping leaving chiller.
   12. Wiring of all related circulating water system chemical treatment devices.
      a. Low voltage electric contacting water meter.
      b. Solenoid valve/blow-down assembly.
   13. Radiant heater timer switches and/or thermostats.
   14. Low Voltage thermostat wiring.

C. Refer to Division 23 Controls Sections for related control system wiring.

D. Refer to Division 23 sections for specific individual mechanical equipment electrical requirements.

E. Refer to Division 26 sections for motor starters and controls not furnished integrally with mechanical equipment.

F. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of mechanical equipment.

1.2 RELATED WORK

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

1.3 QUALITY ASSURANCE

A. Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.

B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.4 SUBMITTALS

A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 - PRODUCTS

2.1 MOTORS

A. Provide motors for mechanical equipment manufactured by one of the following:
1. Baldor Electric Company.
2. Century Electric Div., Inc.
3. General Electric Co.
4. Louis Allis Div.; Litton Industrial Products, Inc.
5. Lincoln Electric
6. Marathon Electric Mfg. Corp.
7. Reliance Electric Co.
8. Westinghouse Electric Corp.
9. WEG.

B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of mechanical equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of mechanical work:

C. Temperature Rating. Rated for 40 Degrees C environment with maximum 50 Degrees C temperature rise for continuous duty at full load (Class A Insulation).

D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.

E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger, and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 23 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.

F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.

G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
1. Frames. NEMA #56.

2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 23 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 23 for other enclosure requirements.
4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
5. Noise Rating: Provide "Quiet" rating on motors.

H. All motors shall be premium efficiency.

I. Provide an inverter duty motor on all equipment that utilizes a variable frequency drive.

2.2 EQUIPMENT FABRICATION

A. Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

2.3 GENERAL REQUIREMENTS – SHAFT GROUNDING RINGS

A. All motors operated on variable frequency drives shall be equipped with a maintenance-free, conductive microfiber shaft grounding ring to meet NEMA MG-1, 3.4.4.4.3 requirements, with a minimum of two rows of circumferential microfibers to discharge damaging shaft voltages away from the bearings to ground. SGR’s Service Life: Designed to last for service life of motor. Provide AEGIS SGR Conductive MicroFiber Shaft Grounding Ring, or approved equal.

B. Application Note: Motors up to 100 HP shall be provided with one shaft ground ring installed on either the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor with the exception of line contact bearings in the drive end of the machine. In this instance the line contact bearing must be electrically insulated and the AEGIS Bearing Protection Ring installed on the opposite drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer’s recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motors on motor mounting systems in accordance with motor manufacturer’s instructions, anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

B. Verify voltage with Electrical Plans.

END OF SECTION

SECTION 23 05 14

HVAC CONDENSATE DRAIN PIPING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide and install air conditioning condensate drains.

1.2 RELATED WORK

A. Division 23 - Mechanical
   1. Insulation.

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

A. Type “L” copper with drainage pattern fittings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the system to facilitate easy removal.
   1. Use threaded plugged tee at each change of direction to permit cleaning.
   2. Install a cleanout every 50 feet of straight run piping.
   3. Maintain a positive slope on all piping.

B. Install a water seal trap leg based on the fan pressure.
   1. Size the length of the trap leg 1 inch larger than the actual system pressure.

C. Install traps and cleanout as shown in the drawing details.
   1. Confirm requirements with manufacturer's installation instructions.

3.2 SIZE PIPE AS SHOWN ON DRAWINGS.

A. Do not install piping sized smaller than the unit drain connection size.

3.3 SECONDARY DRAINS

A. Provide secondary drains where required by code, shown on the drawings, or where equipment has secondary drain connections.

END OF SECTION

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SECTION 23 05 93

TESTING, BALANCING AND ADJUSTING (TAB) OF ENVIRONMENTAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Balance, adjust and test the air distribution system including the exhaust system.

B. Balance, adjust and test the hydronic system.

C. Verify and record the duct test results performed by the mechanical contractor.

1.2 RELATED SECTIONS

A. COORDINATION OF TESTING AND BALANCING

1.3 SUBMITTALS

A. History of the TAB organization.

B. Agency certification.

C. Personnel qualifications.

D. TAB data forms.

E. Instrumentation list.

F. Name of the project supervising engineer.

G. Name and address and contact person of five successfully completed projects of similar size and scope.

H. To perform required professional services, the balancing agency shall have a minimum of one test and balance engineer certified by National Environmental Balancing Bureau.

1.4 TAB FIRM QUALIFICATIONS

A. The organization performing the work shall be a Certified member in good standing of the (NEBB) National Environmental Balancing Bureau.

B. Able to furnish evidence of having contracted for and completed not less than five systems of comparable size and type that have served their Owners satisfactorily for not less than five years.

C. A specialist in this field and have the personnel, experience, training, skill, and the organization to perform the work.

D. The balancing agency shall furnish all necessary calibrated instrumentation to adequately perform the specified services. An inventory of all instruments and devices in possession of the balancing agency may be required by the engineer to determine the balancing agency's performance capability.

E. The balancing agency shall have operated for a minimum of five years under its current name.

F. Personnel:
1. The project supervisor shall be a Professional Engineer registered in Texas.
   a. Extensive knowledge of the work involved.
   b. At least five years experience conducting tests of the type specified.
   c. This test and balance engineer shall be responsible for the supervision and certification of the total work herein specified.
2. All work shall be conducted under the direct supervision of the supervising engineer.
3. Technicians shall be trained and experienced in the work they conduct.

1.5 WARRANTY

A. Provide (NEBB) guarantee in writing.

B. Extended warranty.
1. Include an extended warranty of 2 years after completion of test and balance work, during which time the Architect/Engineer may request a retest or resetting of any outlet or other items as listed in the test report.
2. Provide technicians and instruments to assist the Architect/Engineer in making any tests he may require during this period.
3. The balancing agency shall perform an inspection of the HVAC system during the opposite season from that which the initial adjustments were made. The balancing agency shall make any necessary modifications to the initial adjustments to produce optimum system operation.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 TAB TOLERANCES

A. The water, outside air, supply air, return air, and exhaust air for each system shall be adjusted to within +/- 5% of the value scheduled on the drawings.

3.2 SITE VISITS

A. During construction, the balancing agency shall inspect the installation of the piping systems, sheetmetal work, temperature controls, energy management system, and other component parts of the heating, ventilating, and air conditioning systems. One inspection shall take place when 60% of the ductwork is installed and another inspection shall take place when 90% of the equipment is installed. The balancing agency shall submit a brief written report of each inspection to the architect and engineer.

B. Upon completion of the installation and start-up of the mechanical equipment by the mechanical contractor, the balancing agency shall test and balance the system components to obtain optimum conditions in each conditioned space of the building. If construction deficiencies are encountered that preclude obtaining optimum conditions, and the deficiencies cannot be corrected by the mechanical contractor within a reasonable period of time, the balancing agency shall cease testing and balancing services and advise the architect, engineer, general contractor and owner, in writing, of the deficiencies.

C. Note proper piping installation, location of valves, and flow measuring instruments.

D. Make one series of visits, phased as required by construction progress, prior to installation of the ceiling. Note proper installation of balancing dampers.

E. Continue the site visits up to completion of project. In each succeeding report, list corrections made from previous reports.

3.3 TESTING INSTRUMENTS

A. Submit a list of all instruments to be used for the test and balance procedures.
   1. Catalog sheets.
   2. Certificate of last calibration.
   3. Calibration within a period of six months prior to balancing.

B. Testing equipment shall be in good working order and tested for accuracy prior to start of work.

3.4 COORDINATION WITH OTHER SPECIFICATION SECTIONS

A. Review the related ductwork shop drawings and piping shop drawings. Make recommendations concerning suitability with respect to the testing, balancing and adjusting work.

B. Make tests to verify proper placement of the static pressure sensors for the variable air volume fan system control.

C. In cooperation with the work specified in Building Management and Control System section, a systematic listing of the testing and verification shall be included in the final TAB report. The TAB firm shall provide a laptop computer to operate with the Building Management and Control System. Building Management and Control System shall provide all necessary software and special interface cables, as required, to communicate with the DDC system:
   1. Work with the temperature control contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of the intended control performance.
   2. Verify that all control devices are properly connected.
   3. Verify that all dampers, valves, and other controlled devices, are operated by the intended controller.
   4. Verify that all dampers and valves are in the position indicated by the controller (open, closed or modulating).
   5. Verify the integrity of valves and dampers in terms of tightness of close-off and full open positions. This includes dampers in multizone units, terminal boxes and fire/smoke dampers.
   6. Observe that all valves are properly installed in piping system in relation to direction of flow and location.
   7. Observe the calibration of all controllers.
   8. Verify the proper application of all normally opened and normally closed valves.
   9. Observe the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
   10. Observe the location of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. Control contractor will relocate as deemed necessary by the Engineer.
   11. Verify that the sequence of operation for any control mode is in accordance with the approved shop drawings and specifications. Verify that no simultaneous heating and cooling occurs.
   12. Verify the correct operation of all interlock systems and installation is per the

manufacturer recommendations.

13. Check all dampers for free operation.
14. Verify that all controller setpoints meet the design intent.
15. Perform variable volume system verification to assure the system and its components track with changes from full flow to minimum flow.

D. Upon completion of the testing and balancing, submit three days prior notice that the systems are ready for a running test. A qualified representative of the test and balance organization shall be present, with a representative from the engineers office, to field verify TAB report readings. Specific and random selections of data recorded in the certified test and balance report will be reviewed.

3.5 INSTRUMENT TEST HOLES

A. When it is required to make holes in the field to measure temperature, static pressure or velocity in the ducts:
   1. Drill holes, plug and tape external duct insulation.
   2. Repair damaged insulation to Engineer's approval.

3.6 TESTING THE AIR DISTRIBUTION SYSTEM

A. The TAB agency shall verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set full open. The TAB agency shall perform the following TAB procedures in accordance with National Environmental Balancing Bureau and all results shall be recorded in the TAB report:
   1. Supply Fans:
      a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
      b. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
      c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the main supply and return ducts, as applicable, to obtain total CFM. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.
      d. Outside Air: Test and adjust the outside air on applicable equipment using a Pitot-Tube traverse. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. If a traverse is not practical, use the mixed air temperature method, if the inside and outside temperature difference is at least 20°F, or use the difference between Pitot-tube traverse of the supply and return ducts.
      e. Static Pressure: Test and record system static pressure, including the static pressure profile of each supply fan.
   2. All Other Fans:
      a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
      b. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
      c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the main return ducts, as applicable, to obtain total CFM. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.

d. Static Pressure: Test and record system static pressure, including the static pressure profile of each return fan.

3. Diffusers, Registers and Grilles:
   a. Tolerances: Test, adjust, and balance each diffuser, grille, and register to within 5% of design requirements. Minimize drafts. Observe throws are in direction as indicated on drawings.
4. Coils (including electric coils):
   a. Air Temperature: Once air flows are set to acceptable limits, take wet bulb (cooling coil only) and dry bulb air temperatures on the entering and leaving side of each coil. Calculate the sensible and latent (cooling coil only) capacity of the coil. Provide information in TAB report.

B. Record preliminary air handler data, including fan RPM and static pressures across filter, fans and coils.

C. Perform a velocity traverse of the main supply ducts using a pitot-tube and inclined manometer to establish initial air delivery. Perform a Pitot-tube traverse of main supply and return ducts, as applicable, to obtain total CFM. If a pitot-tube traverse is not practical, a detailed explanation of why a traverse was not made must appear on the appropriate data sheet.

D. Where air measuring stations are installed, use pitot tube traverse readings to verify and record the correct calibration of the stations output.

E. Make adjustments in fan RPM and damper settings, as required, to obtain design supply air, return air, and outside air.

F. Measure and adjust all supply and return branches to design air delivery.

G. Measure and adjust all diffusers to design air delivery to +/- 5% of design requirements.

H. Make a set of recordings showing final system conditions.

3.7 EQUIPMENT POWER READINGS

A. Record the following information for each motor:
1. Equipment designation.
2. Manufacturer.
3. Unit model number and serial number and frame.
4. Motor nameplate horsepower; nameplate voltage; phase and full load amperes.
5. Heater coil in starter.
   a. Rating in amperes.
   b. Manufacturer's recommendation.
6. Motor RPM/driven equipment RPM.
7. Power reading (voltage, amperes of all legs at motor terminals).

3.8 DUCT TEST

A. Test and Balancing Contractor shall verify and record the duct test results. A copy of the duct test results, as completed, shall be submitted to the engineer for review within five days. Provide a complete report of all the duct test results in the final TAB report.

3.9 DIRECT EXPANSION EQUIPMENT

A. With each unit operating at near design conditions, measure and record the following:
   1. Manufacturer, model number, serial number and all nameplate data.
   2. Ambient temperature, condenser discharge temperature.
   3. Amperage and voltage for each phase.
   4. Leaving and entering air temperatures.
   5. Suction and discharge pressures and temperatures.
   6. Tons of cooling.
   7. Verification that moisture indicator shows dry refrigerant.

3.10 TAB REPORT

A. The activities described in this specification shall be recorded in a report form; and four individually bound copies shall be provided to the Architect and Engineer. Neatly type and arrange data. Include with the data the date tested, personnel present, weather conditions, nameplate record of the test instruments used and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy any incorrect situation. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operations personnel. Provide a "Preface" which shall include a general discussion of the system and any abnormalities or problems encountered.

B. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the report must have been recorded on site by the permanently employed technicians or engineers of the TAB firm.

C. Submit reports on forms approved by the engineer that will include the following data as a minimum:
   1. Title Page
      a. Company Name.
      b. Company Address.
      c. Company telephone number.
      d. Project name.
      e. Project location.
      f. Project Manager.
      g. Project Engineer.
      h. Project Contractor.
      I. Project Identification Number.
   2. Summary of the TAB report data.
   3. Index.
   4. Instrument List
      a. Instrument.
      b. Manufacturer.
      c. Model.
      d. Serial Number.
      e. Range.
      f. Calibration Date.
      g. What test instrument is to be used for:.
   5. 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.

6. Return Air/Outside Air Data
   a. Identification/location.
   b. Design return air flow.
   c. Actual return air flow.
   d. Design outside air flow.
   e. Actual outside air flow.
   f. Return air temperature.
   g. Outside air temperature.
   h. Required mixed air temperature.
   I. Actual mixed air temperature.
7. Electric Motors
   a. Manufacturer.
   b. HP/BHP.
   c. Phase, voltage, amperage, nameplate, actual.
   d. PM.
   e. Service Factor.
   f. Starter size, heater elements, rating.
8. V-Belt Drive
   a. Identification/location.
   b. Required driven RPM.
   c. Drive sheave, diameter and RPM.
   d. Belt, size and quantity.
   e. Motor sheave, diameter and RPM.
   f. Center-to-center distance, maximum, minimum and actual.
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 correction factor.
10. Air Monitoring Station Data
   a. Identification/location.
   b. System.
   c. Size.
   d. Area.
   e. Design velocity.
   f. Design air flow.
   g. Test velocity.
   h. Test air flow.
11. Air Distribution Test Sheet
   a. Air terminal number.
   b. Room number/location.
   c. Terminal type.
   d. Terminal size.
   e. Correction factor.
   f. Design velocity.
   g. Design air flow.
   h. Test (final) velocity.

i. Test (final) air flow.

12. Cooling Coil Data

a. Identification/number.
b. Location.
c. Service.
d. Manufacturer.
e. Entering air DB temperature, design and actual.
f. Entering air WB temperature, design and actual.
g. Leaving air DB temperature, design and actual.
h. Leaving air WB temperature, design and actual.
i. Water pressure flow, design and actual.
j. Water pressure drop, design and actual.
k. Entering water temperature, design and actual.
l. Leaving water temperature, design and actual.
m. Air pressure drop, design and actual.
n. Capacity - sensible and latent.

13. Heating Coil Data
    a. Identification/number.
    b. Location.
    c. Service.
    d. Manufacturer.
    e. Entering air DB temperature, design and actual.
    f. Leaving air DB temperature, design and actual.
    g. Water pressure flow, design and actual.
    h. Water pressure drop, design and actual.
    i. Entering water temperature, design and actual.
    j. Leaving water temperature, design and actual.
    k. Air pressure drop, design and actual.
    l. Capacity.
14. Sound Level Report
    a. Location (Location established by the design engineer).
    b. N C curve for eight (8) bands-equipment off.
    c. N C curve for eight (8) bands-equipment on.
15. Vibration Test on equipment having 10 HP motors or greater in size.
    a. Location of points:
        1) Fan bearing, drive end.
        2) Fan bearing, opposite end.
        3) Motor bearing, center (if applicable).
        4) Motor bearing, drive end.
        5) Motor bearing, opposite end.
        6) Casing (bottom or top).
        7) Casing (side).
        8) Duct after flexible connection (discharge).
        9) Duct after flexible connection (suction).
    b. Test readings:
        1) Horizontal, velocity and displacement.
        2) Vertical, velocity and displacement.
        3) Axial, velocity and displacement.
    c. Normally acceptable readings, velocity and acceleration.
    d. Unusual conditions at time of test.
    e. Vibration source (if non-complying).
16. Control verification indicating date performed and any abnormalities identified.
    a. Point Location/Description.
    b. EMS Readout (Setpoint and Actual).
    c. Actual Readout of all points.
    d. Interlocks.
    e. Safeties.
    f. Variable speed drive tracking with EMS input.

g. Variable speed drive Bypass operation.
h. Sequence of operation.

END OF SECTION

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SECTION 23 07 13

EXTERNAL DUCT INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install external insulation on supply, return, exhaust and outside air ductwork.

B. External insulation of concealed and exposed ducts is included in this Section. Internal acoustic duct lining is specified under ductwork and not included in this Section.

1.2 RELATED WORK

A. Division 9 - FINISHES. Painting and Color Coding.

B. Division 23 - MECHANICAL.
1. Air Handling Units. Internal insulation for air units is specified in the sections on air handling units. The units do not require external insulation.
2. Internal Duct Liner. Internal duct liner is specified in the section on ductwork.
3. Insulation. Refer to specific sections on individual insulation types.
4. Refer to insulation and liner plan detail.

1.3 QUALITY ASSURANCE

A. The intent of insulation specifications is to obtain superior quality workmanship, resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.

B. An approved contractor for this work under this Division shall be:
1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

C. All duct insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 as determined by test procedures ASTM E84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.

D. Condensation on any insulated system is not approved.

E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.

F. Where existing insulated ductwork or other services are tapped, remove existing insulation back to undamaged sections and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.4 APPROVALS

A. Submittals. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location, and the manufacturer's installation instructions for each product.

B. Sample Application. Make an application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

PART 2 - PRODUCTS

2.1 INSULATION

A. Glass fiber rigid duct insulation.
   1. Minimum density of 3 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and minimum density of 0.75 pcf, installed R value to be 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.7 mil aluminum foil reinforced with glass yarn mesh and laminated to 40 lbs. fire-resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
   2. Acceptable Manufacturers
      a. Schuller 814 spin-glas FSK.
      b. Owens-Corning Type 703 board RKF.
      c. Knauf 3 PCF FSK.

B. Glass fiber blanket duct insulation.
   1. Minimum density of 1.0 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and minimum density of 0.75 pcf, installed R value to be 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs. fire resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
   2. Acceptable Manufacturers
      a. Manville R-series Microlite FSKL.
      b. Owens-Corning ED100 RKF.
      c. Knauf 1.0 PCF FSK.

C. Fireboard Insulation
   1. Totally encapsulated with foil facing.
   2. Two hour rated fire protection.
   3. Zero clearance to combustible protection.
   4. System shall be listed and labeled by an NRTL.
   5. Tested per ISO 6944, Type A Duct and achieve a 2 hour rating for stability, integrity and insulation.
   6. Provided system is subject to the approval of the Local Authority Having Jurisdiction.
   7. Acceptable Manufacturers
      a. Unifrax ON Fyrewrap Elite 1.5
      b. Partak Insulation, Inc. Paroc Fireboard
      c. Thermal Ceramics FireMaster 3M
      d. Premier Refractories International, Pyroscat.

D. Rigid Closed Cell Insulation
   1. Acceptable Manufacturers
      a. Dow Trymer.
      b. Phenolic Foam.

E. Reinforced Foil Tape
   1. Acceptable Manufacturers
      a. Venture 1525CW.
      b. 3” FSK.
   2. Thickness 6.5 mils.
   3. Color: silver.

2.2 COATING AND ADHESIVE

A. Coating. Provide Childers CP-38 or Foster 30-80 vapor barrier coating. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100ºF and 90% RH per ASTM E96.

B. Outdoors: Provide as insulation coating Childers Encacel X or Foster Monolar 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100ºF and 90% RH per ASTM F 1249.

C. Adhesive. Provide Childers CP-82 or Foster 85-20 vapor barrier adhesive.

D. Reinforcing Mesh. Provide 10 x 10 white glass or polyester reinforcing mesh.

2.3 OUTDOOR DUCT LAMINATED JACKETING

A. Rubberized bitumen compound material:
   1. Ultraviolet resistant.
   2. Weatherproof.
   3. Vapor retarding jacketing.
   4. Laminated jacketing.
   5. Cross-laminated high strength polyethylene film.
   6. Laminated to aluminum foil.
   7. Minimum 60-mil thickness.

B. Acceptable Manufacturers:
   1. Alumaguard 60.
   2. Flex Clad 400.
   3. Venture Clad 1577CW.

PART 3 - EXECUTION

3.1 FIRE SAFETY REQUIREMENTS

A. Do not extend duct coverings through walls or floors required to be fire-stopped or required to have a fire resistance rating. Interrupt duct coverings in the immediate vicinity of heat sources such as electric resistance or fuel-burning heater.

3.2 CONCEALED DUCT

A. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrim-Kraft (FSK) facing.

B. Standing Seams. Insulate standing seams and stiffeners, which protrude through the

insulation with 0.6 lb. per cubic foot density, 1-1/2” thick, faced, flexible blanket insulation. Insulation shall not prevent adjustment of damper operators.

C. Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2”. In addition, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on twelve inch centers to prevent sagging of insulation.

D. Ductwork in mechanical rooms is considered concealed spaces.

3.3 EXPOSED DUCT INSULATION

A. Ductwork in exposed locations is to be insulated with fiberglass rigid / semi-rigid board insulation.
   1. Apply fabric and mastic to provide a smooth surface for painting.

B. Standing Seams: Insulate standing seams and stiffeners which protrude through the insulation with 0.6 lb per cubic foot density, 1-1/2 inch thick, faced insulation. As a vapor seal, use reinforcing mesh with vapor barrier coating. Insulation shall not prevent adjustment of damper operators.

C. Insulation shall be wrapped tightly on the ductwork. Adhere insulation to ductwork with adhesive. In addition, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on 12 inch centers to prevent sagging of insulation.

D. Cover all seams, joints, pin penetrations and other breaks with coating reinforced with reinforcing mesh. Fabric shall not be visible after coating.

3.4 OUTDOOR DUCTWORK COVERING

A. Cover all supply and return ductwork outdoors:
   1. 1-1/2” thick, rigid closed cell insulation with reinforced foil facing.

B. Install a high point in center and slope in both directions so water will not stand on horizontal surfaces.

C. Impale the insulation over mechanical fasteners and washers.
   1. A minimum of 2 rows of fasteners per side on 12-inch centers.
   2. Seal all breaks, joints and punctures by applying a 1/8” thick vapor barrier mastic coating, embedded in open mesh reinforcing mesh.

D. Standing S, or flanged connections shall be covered with the same thickness of insulation overlapped a minimum of 4”.

E. Apply a tack coat of Childers CP-10/11 or Foster 46-50 weather barrier mastic over the entire surface.
   1. While this coat is still tacky, Childers #5 glass fiber reinforcing mesh shall be smoothly applied and pressed into the mastic. The cloth shall be taut with adjacent edges overlapped a minimum of 4”.
   2. After the first coat of mastic has taken its set, the second coat shall be applied over the cloth by palm, trowel, or spray to sufficient thickness that, when dried, the combined thickness of mastic and cloth is not less than 1/8”.
   3. Upon completion, the openings in the cloth shall be completely sealed and the yarn shall not be visible. The completed work shall be completely smooth and

present a plane surface.

4. Aluminum gray or white finish as approved by the Architect.

F. Standing water on horizontal surfaces is not approved.

G. Apply outdoor duct laminated jacketing protection over entire insulation surface. Apply rubberized bitumen compound, applied to a cross-laminated high strength polyethylene film, laminated to aluminum foil.

3.5 KITCHEN GREASE EXHAUST DUCTWORK / KILN DUCTWORK / FUME HOOD DUCT

A. Secure fireboard insulation to duct with impaling pins and 3” square speed clips. In addition, provide a wire mesh support system and additional sealing or support as required by the code enforcing authority. The insulation support system shall include framed access to allow the insulation to be removed and replaced without damage at the access doors in the duct system for inspection and cleaning. Coordinate location of access openings to correspond accurately. Provide stainless steel banding on 12” centers.

3.6 GENERAL INSTALLATION

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

B. Apply insulation on clean, dry surfaces only.

C. Continue insulation with vapor barrier through penetrations.

D. Neatly finish insulation at supports, protrusions and interruptions.

E. Install insulation on clean, dry surfaces, and only after building is weatherproofed sufficiently to preclude any rainwater on insulation.

F. Apply mastic over the fiberglass reinforcing mesh to a thickness where fabric is not visible after completion.

G. Install fiberglass blanket duct insulation on top of supply air grilles not fire rated.

END OF SECTION

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SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install piping insulation, jackets, accessories and covering of specified materials. The insulation shall be used for high and low temperature piping applications including refrigerant lines and condensate piping.

1.2 QUALITY ASSURANCE

A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.

B. An approved contractor for this work under this Division shall be:
   1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
   2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their owners satisfactorily for not less than 3 years.

C. All piping insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.

D. Condensation on any insulated piping system is not acceptable.

E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.

F. Where existing insulated piping, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.3 SUBMITTALS

A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.

B. Make a field application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

1.4 RELATED WORK

A. Finishes. Painting and color-coding.

B. Pipe Heat Tracing.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Glass fiber pipe insulation:
   1. Johns-Manville Micro-Lok AP-T.
   2. Owens-Corning ASJ/SSL.
   3. Knauf ASJ/SSL.

B. Cellular Glass Insulation (Foamglass):
   1. Pittsburg Corning.
   2. Cell-U-Foam.

C. Rigid Foam Insulation:
   1. Kingsapan Tarec.
   2. Dow Trymer.
   3. Tarec Ecophen – Phenolic Foam.

D. Aluminum Jacketing:
   1. ITW Lock-on (Childers).
   2. ITW Z-lock (Pabco).

E. Fiberglass reinforcing cloth mesh:
   1. Perma Glass Mesh.
   2. Alpha Glass Mesh.
   3. Childers Chil-Glas.
   4 Foster Mast a Fab.
   5. Vimasco.

F. Mastics, Sealants, Coatings and Adhesives
   1. Childers.
   2. Foster.
   3. Vimasco.
   4. Armacell 520 Adhesive.

G. Elastomeric Insulation
   1. Armacell.

H. Weather Resistant Coating
   1. WB Armaflex Finish.
   2 Foster 30-64.

I. Glass fiber blanket insulation
   1. Manville R-series Microlite FSKL.
   2. Owens-Corning eD75 or ED100 RKF.
   3. Knauf 0.75 PCF FSK.

2.2 RIGID FOAM PIPE INSULATION

A. Polyisocyanurate pipe insulation or phenolic foam pipe insulation, with all service reinforced vapor barrier jacket having integral laminated vapor barrier.
   1. Polyisocyanurate: Thermal conductivity 0.14 @ 75°F mean (ASTM C518).
   2. Phenolic Foam: Thermal conductivity 0.13 @ 75°F mean (ASTM C 518); minimum 2.5# density.
   3. Polyisocyanurate is not to be used inside of buildings without 25/50 rating.

2.3 FIBERGLASS PIPE INSULATION

A. Heavy density, dual temperature fiberglass insulation with factory applied, all service, reinforced vapor barrier jacket having integral laminated vapor barrier. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Supply in thickness as shown.
   1. Thermal conductivity 0.23 @ 75°F mean (ASTM 335).

2.4 ELASTOMERIC INSULATION

A. Insulation material shall be flexible, closed-cell elastomeric insulation in tubular or sheet form. Material shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, latest revision. Sheet material with a thickness greater than ¾” shall have a flame spread rating of 25 or less and a smoke developed rating of 100 or less when tested in accordance with ASTM E84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive. In addition, all materials shall pass simulated end-use fire test.
   1. Thermal conductivity 0.27 at 75°F mean (ASTM C177 or C518).

2.5 CELLULAR GLASS INSULATION

A. ASTM C552:
   1. "k" value of 0.35 @ 75°F ("ksi" value of 0.047 @ 24°C);
   2. 8.0 lb/cu.ft. (128 kg/cu.m.) density.

2.6 INSULATION/SHIELD AT HANGERS

A. Field fabricated: Use 360° sections of rigid foamglass insulation that will support the bearing area at hangers and supports. Further support insulation at hangers and supports with a shield of galvanized metal covering at least half of the pipe circumference, and conforming to the schedule. Insulation shall extend at least 1” beyond metal shield on each end. When pipe is guided at top and bottom, metal shields shall cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide with respect to insulation with ½” aluminum bands (2) per shield.
   1. Sections of foam glass insulation may be used of the same outside diameter of the adjoining pipe insulation.
   2. Minimum thickness of foam glass insulation shall not be less than 1” thick.

B. Pipe saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter or more than 22”. Provide 18 gauge through 4” pipe and 16-gauge 5” pipe and above.

2.7 SEALANT, ADHESIVE AND FINISH

A. Lap Adhesive. Provide Childers CP-82 or Foster 85-20 adhesive.

B. Vapor Barrier Finish:
1. Indoors: Provide as insulation coating Childers CP-38 or Foster 30-80, white. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100ºF and 90% RH per ASTM E96.
2. Outdoors: Provide as insulation coating Childers Encacel X or Foster 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100ºF and 90% RH per ASTM F 1249 and must be Hypalon rubber based.
3. Underground: Provide Childers CP-22/24 or Foster 60-25/26 for fittings and areas. Pittwrap cannot be used.

C. Insulation Joint Sealant. Provide Childers CP-76 or Foster 95-50 vapor barrier sealant.

D. Metal Jacketing Sealant. Provide Childers CP-76 or Foster 95-44 metal jacketing sealant for all outdoor metal jacketing laps.

E. Lagging Adhesive. Provide Childers CP-50AMV1 or Foster 30-36.

F. Other products of equal quality will be acceptable only upon approval.

2.8 ALUMINUM JACKETING

A. Finish insulated piping outdoors with a smooth prefabricated Z-lock aluminum jacket 0.016” thick with factory applied 1 mil polyethylene/40 lb and Fab strap. Kraft moisture barrier.

B. Valves, Fittings and Flanges. For finishing valves, fittings, flanges and similar installations, provide formed aluminum covers, 0.024” thick.

C. Straps and Seals. Provide ½” x 0.020 stainless steel strapping and seals for jackets and covers according to manufacturer's recommendations.

2.9 GLASS FIBER BLANKET INSULATION

A. Minimum density of 1.0 PCF, 2” thick, installed R value to be 6.0 or better at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs fire resistant kraft.

PART 3 - EXECUTION

3.1 INTERIOR PIPING

A. Cover all piping with glass fiber, heavy density, dual temperature pipe insulation with a vapor barrier jacket. Apply insulation to clean, dry pipes. Longitudinal seams shall be joined firmly together and sealed with self-sealing lap joints. Butt insulation joints firmly together and seal with a 3” wide ASJ butt strip seal. Longitudinal seams and butt strip laps shall be coated and sealed with CP-38 or Foster 30-80 vapor barrier coating for chilled water piping applications.

B. Install hanger with protective shield, on the outside of all insulation.

C. Where domestic water pipes (1/2” & ¾” pipe sizes) are installed on trapeze type hangers,

provide galvanized sheet metal protection shields at these locations. Place insulation jacket directly on hanger. Incompressible, load bearing insulation segments are not required.

D. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter. Provide 18-gauge through 4” pipe and 16-gauge for 5” pipe and above.

E. Seal ends of pipe for chilled water insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe making a complete seal.

F. Apply a smooth flood coat of white lagging adhesive Foster 30-35 or Childers CP-35 over all exposed insulation within mechanical rooms.

G. Piping to be insulated as specified above:
1. Chilled water and heating water.
2. Make-up water.
3. Horizontal sanitary drain piping that receives condensate.
4. Condenser water.

3.2 REFRIGERANT AND CONDENSATE PIPING

A. Cover all pipe with elastomeric insulation by slitting tubular sections or sliding unslit sections over the open ends of piping or tubing. Seams and butt joints shall be adhered and sealed using Foster 85-75, Childers CP-82 or Armstrong 520 Adhesive.

B. All fittings shall be insulated with the same insulation thickness as the adjacent piping. All seams and mitered joints shall be adhered with Foster 85-75, Childers CP-82 or 520 Adhesive.

C. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter.

D. Outdoor exposed piping shall be painted with two coats of either WB or SB Armaflex finish or Foster 30-64 elastomer foam coating. All seams shall be located on the lower half of the pipe.

E. Outdoor exposed piping after being sealed as noted above apply aluminum jacketing to protect piping insulation exposed to weather, from damage from sunlight, moisture, equipment maintenance, wind, and shall provide shielding from solar radiation. Adhesive Tape shall not be permitted.

3.3 FLANGE, VALVE AND FITTING INSULATION

A. Cover valves and flanges with fabricated segments, fittings with two-piece factory molded fittings, and both of matching pipe insulation type and thickness equal to that of the adjoining pipe. Fittings and fabricated segments shall be securely held in place.
1. Apply a tack coat of insulating coating/mastic to the insulated fitting to produce a smooth surface.
2. After mastic is dry, apply a second coat of vapor barrier coating/mastic. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.
3. Overlap coating/mastic and fiberglass/polyester reinforcing mesh by 2” on adjoining sections of pipe insulation.

4. Apply a second coat of coating/mastic over the fiberglass/polyester reinforcing mesh to present a smooth surface.
5. Apply coating/mastic to a wet film thickness of 3/64”.
6. Fabric shall not be visible after completion.
7. Vapor seal flanges, valves and fittings with Childers CP-38 or Foster 30-80. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100ºF and 90% RH per ASTM E96.

B. PVC fitting covers are not acceptable.

3.4 MISCELLANEOUS

A. Insulate pumps.

B. Install materials after piping has been tested and approved.

C. Apply insulation on clean, dry surfaces only.

D. Apply weather protective finish on elastomeric insulation installed in non-conditioned spaces. Provide a minimum of three coats.

3.5 INSULATION THICKNESS

INSULATED UNIT	THICKNESS (Inches)
Refrigerant Piping	1-1/2
Condensate Drains	1

END OF SECTION

SECTION 23 20 00

HVAC PIPE AND PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install pipe and pipe fittings for piping systems specified in Division 23 - Mechanical.

1.2 RELATED WORK

A. Division 23 Mechanical:
   1. Vibration Isolation.
   2. Insulation.
   3. Other Piping Sections.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. The particular type of pipe and fittings for each system is specified in the individual sections.

2.2 JOINTS

A. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.

B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions or couplings such as Crane Company #1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.

C. Solder joints.
   1. Prior to making joints, cut pipe square and ream to full inside diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
   2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
   3. Use silver brazing alloy or Sil-Fos on refrigerant piping and on underground piping. Use lead free solder on all other copper piping.

D. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. The use of mitered joints is not approved.

E. Flanged.
   1. Prior to installation of bolts, center and align flanged joints to prevent mechanical pre-stressing of flanges, pipe or equipment. Align bolt holes to straddle the vertical, horizontal or north-south centerline. Do not exceed 3/64" per foot inclination of the flange face from true alignment.
   2. Use flat-face companion flanges only with flat-faced fittings, valves or equipment. Otherwise, use raised-face flanges.

3. Install gaskets suitable for the intended service and factory cut to proper dimensions. Secure with manufacturers recommended gasket cement.
4. Use ANSI nuts and bolts, galvanized or black to match flange material. Use ANSI 316 stainless steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
5. Use carbon steel flanges conforming to ANSI B16.5 with pipe materials conforming to ASTM A 105 Grade II or ASTM A 108, Grade II, ASTM A 53, Grade B. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
6. Keep flange covers on equipment while fabricating piping. Remove when ready to install in system.

F. Mechanical Joints: Provide a stuffing box type mechanical joint adapted to use gasket, cast iron gland and bolts. Coat bolts with bitumastic enamel. Use joint parts similar in design to one of the following:
1. Doublex Simplex Joint manufactured by the American Cast Iron Pipe Company, Birmingham, Alabama.
2. U.S. joints manufactured by the United States Pipe and Foundry Company, Burlington, New Jersey.
3. Boltite Joint manufactured by the McWane Cast Iron Pipe Company, Birmingham, Alabama.
4. Flexlamp manufactured by the National Cast Iron Pipe Company, Birmingham, Alabama.

2.3 UNIONS

A. Use 150 lb. standard (300 lb. WOG) malleable iron, ground joint unions with bronze seat. Provide flanged joints on piping 2-1/2" and larger.
1. Where pipe material of different types join, use a dielectric union. Union shall be threaded, solder or as required for its intended use.

2.4 BRANCH CONNECTIONS

A. Pipe 2" and Smaller: For threaded piping, use straight size reducing tee. When branch is smaller than header, a nipple and reducing coupling or swagged nipple may be used.

B. 2-1/2" through 36": For welding piping, when branch size is the same as header size, use welding tee. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.

2.5 GASKETS

A. High Temperature Piping: Provide 1/16" thick ring gaskets of aramid reinforced SBR such as Garlock #3200 or 3400 or equal by Advanced Products and Systems.

B. Other Piping: Provide ring rubber gaskets, Garlock #7992 or equal by Advanced Products and Systems. Use 1/8" thick cloth reinforced neoprene gaskets. For smaller than 6", use 1/16" thick gasket.

2.6 FLOORS AND CEILING PLATES

A. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas; size plates to fit pipe or insulation and lock in place.

2.7 DOMESTIC MANUFACTURE

A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America.

PART 3 - EXECUTION

3.1 PIPE FABRICATION AND INSTALLATION

A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufactured, for maintenance.

B. Cut all pipes to measurement determined at the site. After cutting pipe, remove burrs by reaming. Bevel plain ends of ferrous pipe.

C. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make changes in direction. Field bending and mitering is prohibited. Make connections to equipment using flanged joints, unions or couplings. Make reducing connections with reducing fittings only.

D. Install piping without tapping out of the bottom of pipe.

3.2 WELD

A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping.

B. Align piping and equipment so that no part is offset more than 1/16". Set fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.

C. Do not permit any weld to project within the pipe so as to restrict flows. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.

D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.

E. Remove dirt, scale and other foreign matter from inside piping before tying into existing piping sections, fittings, valves or equipment.

F. Bevel ends of ferrous pipe.

3.3 OFFSETS AND FITTINGS

A. Due to the small scale of drawings, the indication of offsets and fittings is not possible. Investigate the structural and finish conditions affecting the work and take steps required to meet these conditions.

B. Install pipe close to walls, ceilings and columns so pipe will occupy minimum space. Provide proper spacing for insulation coverings, removal of pipe, special clearances, and offsets and fittings.

3.4 SECURING AND SUPPORTING

A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging. Review structural drawings for additional information.

B. Provide supports both sides and within 12” of each horizontal elbow for pipe 6" and larger.

C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed. Provide structural support for piping penetrating chase walls to fixtures. On chilled water pipe supports shall be outside the insulation.

D. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section and are sized in accordance with the schedule on the drawings.

E. Install trapeze hangers, properly sized, to support the intended load without distortion. Use hangers with 1-1/2” minimum vertical adjustment.

F. Use electro-galvanized or zinc plated beam clamps if acceptable to the structural engineer, threaded rods, nuts, washers and hangers. All hanger rods shall be trimmed neatly so that no more than 1 inch of excess hanger rod protrudes beyond the hanger nut. Use only on beams as directed by the Structural Engineer.

G. At outdoor locations, all supports, brackets and structural members shall be hot-dipped galvanized.

H. Provide hangers within 3' of pipe length from all coil connections.

I. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Copper & Steel Max. Support Spacing, Ft.	Cast Iron Max. Support Spacing, Ft.	Minimum Rod Diameter, Inches
1" & smaller	6		3/8
1-1/4" & 1-1/2"	8	5	3/8
2"	10	5	3/8
3"	10	5	1/2
4" & 5"	10	5	5/8
6" and above	10	5	3/4

3.5 PIPE SUPPORTS

A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanized members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.

B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to

assure that the lower U-strap will not move in on the bolt. Provide adjustable clevis with a nut / washer above and below the hanger on the support rod. Ring type clevis hangers are not acceptable.

C. Provide Anvil Figure 45 galvanized or primed and painted channel assembly for trapeze hangers.

3.6 PIPE SUPPORTS ON ROOF

A. Support condensate drain pipe on roof with Portable Pipe Hanger Model PP-10 with roller and fully adjustable height throughout pipe run. Base material shall be high density / high impact polypropylene with UV inhibitors and anti-oxidants. Provide with hot dip galvanized rod finish and framing. Nuts and washers shall be hot dip galvanized.

3.7 ANCHORS

A. Provide anchors as required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe. When possible, install sleeves in structural concrete prior to pouring of concrete.

3.8 FLOOR PENETRATIONS

A. At locations where pipe passes through floors, provide watertight concrete curb around penetration.

3.9 PIPE SLEEVES

A. Sleeves through masonry and concrete construction:
   1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
   2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.

B. Sleeves through gypsum wall construction.
   1. Fabricate sleeves of 16 gauge galvanized sheet metal.

C. Sleeves through elevated slab construction.
   1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.

D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2” above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.

E. Caulk sleeves water and air tight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.

F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.

G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.

H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.10 ISOLATION VALVES

A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for equipment, to isolate central plant, and at other locations.

3.11 DRAIN VALVES

A. Install drain valves at low points of water piping systems so that these systems can be entirely drained. Install a line size drain valve for pipes smaller than 2" unless indicated otherwise. For pipes 2-1/2" and larger, provide 2" drain valves unless indicated otherwise. Drain valves shall be plugged when not in use and at completion.

3.12 CLEANING OF PIPING SYSTEMS

A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge and circulate. Flush the chilled and hot water systems utilizing the filter feeders.

B. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow down ball valve and pipe to nearest drain. Blow down strainers, remove and clean as frequently as necessary.

C. Phase One: Initial flushing of system. Remove loose dirt, mill scale, weld beads, rust and other deleterious substances without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until “potable water clear” and particles larger than 5 microns are removed.

D. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.

E. Dispose of water in approved manner.

F. Phase Two: Cleaning of Piping Systems. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), welding and soldering flux, mill varnish, piping compounds, rust (iron oxide) and other deleterious substances not removed by initial flushing. Chemical shall be equal to Nalco 2578 prepping compound. Insert anti-foam compound as necessary. Circulate for 48 hours or as recommended by the manufacture. Dispose of water in approved manner. Flush system and replace with clean water. Verify compatibility of chemicals used with existing chemical treatment program on remodel projects.

G. Phase Three: Final flushing and rinsing: Flush and rinse until “potable water clear” and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.

H. Submit status reports upon completion of each phase of work on each system.

I. Special requirements, if any, are specified in the sections on each type of piping or in the section on Water Treatment Systems.

3.13 TESTING

A. Test piping after installation with water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.

B. Do not insulate or conceal piping systems until tests are satisfactorily complete.

C. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.

D. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.14 PIPE MARKERS

A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.

B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; background colors of markers, arrows and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.

C. Install identification in the following locations:
1. both sides of penetrations through walls, floors and ceilings.
2. Close to valves or flanges.
3. Intervals on straight pipe runs not to exceed 50 feet
4. Apply marker where view is obstructed.

D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 “Scheme for Identification of Piping Systems”.

END OF SECTION

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SECTION 23 23 00

REFRIGERANT PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install copper tubing, valves, strainers and sight glass for refrigerant piping.

1.2 RELATED WORK

A. Division 23 Mechanical.
   1. Pipe and Pipe Fittings.
   2. Piping Insulation.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Furnish refrigerant piping of Type K hard-drawn copper tubing with sweat-type, wrought copper fittings. Cast fittings are not permitted.

2.2 SERVICE VALVES

A. Provide angle or globe service valves, with sweat connections. Use packed-type, wrench operated, valves with gasketed seal cap and back seat feature. Furnish valves designed for refrigerant service, in conformance with the ARI code.

B. Place service valves at the inlet and outlet of each compressor, on both sides of each strainer and solenoid valve, and as otherwise shown and specified.

2.3 SOLENOID VALVES

A. Furnish pilot-operated, floating-piston solenoid valves suitable for operation with refrigerant.

B. Use valves with a bronze body and sweat-type connections.

C. Provide stainless steel stem and plunger assembly and a stainless steel piston.

D. Furnish sealed and moisture proof solenoid coils.

E. Use electrical characteristics of 115 volt, 60 Hertz.

2.4 SIGHT GLASSES

A. Provide suitable moisture and liquid sight glass in the liquid line leaving the condenser or receiver.

2.5 FILTER DRYER

A. Furnish replaceable core liquid line filter dryer.

B. Provide filter dryer constructed to permit the removal of the core element without removing the filter dryer from the line.

PART 3 - EXECUTION

3.1 BRAZING

A. During the brazing process, dry nitrogen shall be purged through the tubing to prevent oxides from forming.

3.2 PRESSURE TEST

A. After refrigeration and piping system items are installed, charge the system with dry nitrogen and test to 450 psig.
   1. Test joints with a Halide torch or an electronic leak detector.
   2. Repair leaks and retest each system until proved tight.

3.3 EVACUATION AND DRYING

A. After refrigerant system has been pressure-tested, connect a suitable vacuum pump and evacuate piping system, including lines and equipment.
   1. Maintain a vacuum as high as practicable for long enough to evaporate the moisture in the system (at least 48 hours).
   2. Check the humidity within the system with a wet bulb indicator, and maintain the vacuum until the wet bulb temperature is reduced to -40°F. After the system has been evacuated and dried, break the vacuum by charging proper refrigerant into the system.

3.4 PIPE SIZE

A. Pipe shall be routed and sized per condensing unit manufacturer’s instructions.

END OF SECTION

SECTION 23 31 13

DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Duct construction, support and accessories. Dimensions shown on the drawings are free area dimensions.

1.2 RELATED WORK

A. Division 23 Mechanical
   1. Air Devices.
   2. Insulation.
   3 Fan Coil Units.
   4. Fans.
   5. Packaged Rooftop Air Conditioners.
   6. Testing, Balancing and Adjusting (TAB) of Environmental Systems.

B. Division 9 – Finishes, Painting and Color Coding.

1.3 QUALITY ASSURANCE

A. The intent of ductwork specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide ductwork in accordance with the specifications for each type of service.

B. An approved contractor for this work under this division shall be:
   1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
   2. Able to furnish evidence of having contracted for and installed not less than 5 systems of comparable size and type that have served their owners satisfactorily for not less than 5 years.

1.4 GUARANTEE

A. Guarantee ductwork for 1 year from the date of substantial completion. The guarantee covers workmanship, noise, chatter, whistling, or vibration. Ductwork shall be free from pulsation under conditions of operation.

1.5 CONTRACTOR COORDINATION

A. Erect ducts in the general locations shown, but conform to structural and finish conditions of the building. Before fabricating any ductwork, check the physical conditions at the job site and make necessary changes in cross sections, offsets, and similar items, whether they are specifically indicated or not.

B. Coordinate location of ductwork with structural members and Architectural drawings and requirements.

1.6 SHOP DRAWINGS AND SAMPLES

A. Submit shop drawings of all ductwork layouts, including enlarged plans and elevations of all air handling equipment, and summit details of duct fittings, including particulars such

as gauge sizes, welds, and configurations prior to starting work.

B. Submit product data and sealing materials to be used.

C. Submit sound attenuation data.

D. Submit shop drawings in plan, elevation and sections, and three-dimensional view showing equipment in mechanical equipment areas.

PART 2 - PRODUCTS

2.1 STANDARDS AND CODES

A. Except as otherwise indicated, sheet metal ductwork material and installation shall comply with the latest edition of SMACNA HVAC Duct Construction Standards. Air distribution devices (such as dampers) included in this specification shall comply with the latest applicable SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems and NFPA 90A.

2.2 DUCT MATERIAL AND CONSTRUCTION

A. Except for the special ducts specified below use lock forming quality prime galvanized steel sheets or coils up to 60" wide. Stencil each sheet with gauge and manufacturer's name. Stencil coils of sheet steel throughout on 10' centers with gauge and manufacturer's name. Provide certification of duct gauge and manufacturer for each size duct.

B. Rectangular low and medium pressure duct constructed of sheet metal in accordance with the latest edition of SMACNA HVAC Duct Construction Standards.

C. Low pressure round ducts shall be shop fabricated with snap lock longitudinal seams. Ducts shall be constructed for a minimum of 2" w.g. static pressure.

2.3 DUCT SEALING OF SEAMS AND JOINTS

A. Follow seal classification as indicated in Table 1-2 of SMACNA "HVAC AIR DUCT LEAKAGE TEST MANUAL". Use seal class A for 4" w.g. static. All longitudinal and transverse joints and seams shall be sealed by use of a fireproof, non-hardening, and non-migrating elastomeric sealant. With the exception of continuously welded joints and machine made spiral lock seams, joints and seams made air tight with duct sealer.
   1. Indoor applications – Foster 32-14.
   2. Outdoor applications – Foster 32-17.

2.4 FLEXIBLE DUCT LOW PRESSURE

A. Construction:
   1. Continuous galvanized spring steel wire helix, with reinforced metalized cover
      a. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.
   2. UL 181 Class I air duct label.
   3. Reinforced vapor barrier jacket.
   4. Rated for use at system pressure (6" wc minimum).
   5. Flexible duct connections from lateral taps to variable volume boxes or terminal boxes shall be rated at twice the maximum pressure rating of the medium pressure system.

B. Fire hazard classification:
   1. Flame spread rating 25 maximum.
   2. Smoke developed rating 50 maximum.

C. Thermal characteristics:
   1. R-6 BTU/hr/sq. ft./°F (when located in a conditioned plenum).
   2. R-8 BTU/HR/Sq.Ft./°F (when located in an unconditioned plenum).
   3. 2" minimum wall thickness insulation with 1" overlap.

D. Acceptable manufacturers:
   1. Flexmaster.
   2. Hart & Cooley.
   3. Omniair.
   4. Peppertree Air Solutions.

2.5 WALL LOUVERS

A. Refer to schedule on drawings. Coordinate with Architectural Drawings.

B. All louver frames shall be a minimum of 0.08" extruded aluminum. All blades shall be a minimum of 0.081" extruded aluminum. Beginning point of water penetration at 0.01 oz/sq.ft. Shall be a minimum of 800 ft/min.

C. Provide all louvers with removable aluminum bird screen with 1/4" mesh.

D. Louvers shall be AMCA-550 tested and approved.

E. Acceptable manufacturers:
   1. American Warming and Ventilation
   2. Arrow
   3. Greenheck
   4. NCA
   5. Pottorff
   6. Ruskin

2.6 STORM SHELTER WALL LOUVERS

A. Refer to schedule on drawings. Coordinate with Architectural Drawings.

B. All louver frames shall be a minimum of 0.08" extruded aluminum. All blades shall be a minimum of 0.081" extruded aluminum. Beginning point of water penetration at 0.01 oz/sq.ft. Shall be a minimum of 800 ft/min.

C. Provide all louvers with removable aluminum bird screen with 1/4" mesh.

D. Louver performance shall be certified in accordance with the AMCA 511 Certified Ratings Program for AMCA 500-L Air Performance and Water Penetration and shall be licensed to bear the AMCA seal.

E. Louvers shall be UL Classified (Wind-storm Rated) and shall be tested in accordance with the ICC 500-2014 debris impact standard of a 15 lb. 2 x 4 traveling at 100 mph as per the requirements indicated within the FEMA 361 construction guidelines for a FEMA 361 or FEMA 320 compliant storm shelter or safe room.

F. Louvers shall be capable of withstanding positive or negative wind pressure loads up to 250 psf when installed in accordance with the manufacturer’s published installation instructions.

G. Acceptable manufacturers:
   1. Ruskin (XP500)
   2. United Enertech (FEMA-5)
   3. Greenheck (AFL-501)
   4. Pottorff (XAV-505)
   5. Airolite (AFG501)

2.7 DUCT LINING

A. Duct lining shall be 1" thick, 1-1/2 lb. density, flexible lining coated on the air stream side to reduce attrition. Liner shall be Schuler Lina-Coustic, Certain-Teed Ultralite, or equal meeting requirements of NFPA 90-A. Provide I.A.Q. rated liner.

2.8 CONTROL DAMPERS

A. Opposed blade dampers for 2-position and modulating control. Construct frames of 13-gauge galvanized sheet metal with provisions for duct mounting. Damper blades not exceeding 8" in width, of corrugated-type construction, fabricated from two sheets of 22-gauge galvanized sheet metal spot-welded together or a single 16-gauge sheet. Make bearings of nylon or oil-impregnated, sinthered bronze. Make shafts of 1/2" zinc-plated steel. Blades suitable for high velocity performance. Construct damper so that leakage does not exceed 1/2% based on 2000 fpm and 4" static pressure. Provide replaceable resilient seals along top, bottom and sides of frame and along blade edge. Submit leakage and flow characteristics data with shop drawings. Linkage shall be concealed out of the air stream within damper frame to reduce pressure drop and noise.

B. Acceptable Model is Ruskin Model CD60.

2.9 VOLUME DAMPERS

A. Manual balancing dampers that meet or exceed the following minimum construction standards:
   1. Frame 16-gauge.
   2. Blades 16-gauge.
   3. Bearings corrosion resistant.
   4. Concealed linkage.
   5. Opposed blade dampers.

B. Acceptable manufacturer:
   1. Ruskin Model MD-35 or approved equal, by.
   2. Arrow.
   3. American Warming and Ventilating.
   4. Nailor Industries.
   5. Pottoroff.

2.10 SMOKE DAMPERS

A. Smoke dampers meeting the following requirements.
   1. Each smoke damper shall be classified by Underwriters Laboratories as a leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. The damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be Leakage Class II.
   2. The damper frame shall be a minimum of 16 gauge, galvanized steel, formed into

a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non-electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in the damper frame. The dampers shall be opposed blade type. The blades shall be constructed with a minimum of 16 gauge, galvanized steel. The blade edge seal material shall be able to withstand 450°F. The jamb seals shall be flexible stainless steel compression type.

3. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4" water gauge in the closed position, and 2,000 fpm air velocity in the open position.
4. Provide UL555S qualified electric actuator at 120 VAC.
5. Provide air-foil type blades.

B. Provide integral sleeves.

C. Acceptable Manufacturers:
1. Ruskin.
2. Air Balance, Inc.
3. Greenheck, Inc.
4. Nailor Industries.
5. Pottoroff.

2.11 DIFFUSER FITTINGS LOW PRESSURE TAPS

A. Fitting shall meet or exceed the following minimum construction standards:
1. Conical with a base diameter two inches larger than the tap diameter.
2. Construct fitting and damper of galvanized steel in accordance with ASTM A 527, G90 finish.
   a. Fitting with a 3/16-inch high stop bead approximately 2-1/2-inches from the discharge end of the fitting.
   b. Provide the fitting with a butterfly damper, damper rod, end bearings and heavy duty locking quadrant.
   c. Size the length of the straight section of the fitting to match the damper blade diameter. Center the damper blade in the straight section.
3. Match the fitting body gauge to the SMACNA duct gauge, but not less than:
   a. Through 8 inches: 26 gauge; Damper blade 22 gauge.
   b. 10 inches and 12 inches: 24 gauge; Damper blade 22 gauge.
   c. 14 inches and 16 inches: 22 gauge; Damper blade 22 gauge.
   d. 18 inches and 20 inches: 20 gauge; Damper blade 20 gauge.
4. Fasten damper blade to a 3/8 X 3/8 continuous square rod with minimum (2) galvanized U-bolts.
5. Support the damper rod to the fitting with airtight nylon end bushings / bearings.
6. Provide the damper with a self-locking regulator and handle.
7. Provide a 2” sheet metal stand-off to extend the regulator.
8. Flex duct grip area – 2 inches behind retaining bead.
9. Flex duct retaining bead – 1 inch from end.
10. Conical length of at least 3 inches.
11. Barrel length of at least 9 inches.

2.12 AUXILIARY DRAIN PANS

A. Galvanized steel, same gauge and same bracing or cross breaks as a duct with same dimensions. Sides of pan turned up to 1-1/2”, all joints soldered watertight. Pan is to be large enough to complete cover drip lines of unit.

2.13 DUCTWORK SUPPORTS ON ROOF

A. Support ductwork on roof with Portable Pipe Hanger Model PHP-D fully adjustable height and width. Base material shall be high density / high impact polypropylene with UV inhibitors and anti-oxidants. Provide with hot dip galvanized framing. Nuts and washers shall be hot dip galvanized.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use construction methods and requirements as outlined in SMACNA HVAC Duct Construction Standards as well as SMACNA Balancing and Adjusting publications, unless indicated otherwise in the specifications. Refer to details on the drawings for additional information.

B. Reinforce ducts in accordance with recommended construction practice of SMACNA. Provide additional reinforcement of large plenums as required to prevent excessive flexing and or vibration.

C. Cross break or bead sheet metal for rigidity, except ducts that are 12" or less in the longest dimension.

D. Where ducts pass through walls in exposed areas, install suitable escutcheons made of sheet metal angles as closers.

E. At locations where ductwork passes through floors, provide watertight concrete curb around penetration.

F. Support ducts where passing through floors with galvanized steel structural angles of adequate bearing surface.

G. Metal or lined ductwork exposed to view through grilles, registers, and other openings shall be painted flat black. Do not install grilles, registers, or similar items until painting is complete.

H. Fire Dampers shall be installed per manufacturer’s recommendations to create a UL rated assembly.

I. Install end bearing at all location where damper shaft penetrates duct wall.

J. Clean duct to remove accumulated dust. Ducts shall be closed on ends between phases of fabrication to assure that no foreign material enters the ducts.

3.2 DUCTWORK

A. Construct rectangular ducts and round ducts in accordance with the latest SMACNA HVAC Duct Construction Standards. Use the static pressure specified on the air handling unit schedule or fan schedules as a minimum for duct construction. All ductwork between the variable volume air handling units and the terminal units shall be constructed to the medium pressure ductwork specification.

B. Provide adjustable, galvanized splitter-dampers, pivoted at the downstream end with appropriate control device at each supply duct split.

C. For branch ducts wider than 18", and when shown on drawings provide extractors with an

appropriate control device at each rectangular zone or branch supply duct connection. Provide controllers for extractors. Branch ducts shall have a 45° angle in the direction of flow. Do not provide extractor at branch ducts to sidewall registers where the registers are within 10 feet of the main duct.

D. Shop manufactured curved blade scoops may be used for branch duct takeoffs up to 18" wide. Taper scoop blade to the end, to prevent any sagging that may cut into, or damage duct liner if specified during operation.
   1. Construct shop manufactured scoops and splitter blades of galvanized sheet metal 2 full gauges heavier than equivalent sheet metal gauge of branch duct (up to 16 gauge).
   2. Check extractors, scoops and splitter blades thoroughly for freedom of operation. Oil bearing points before installing.

E. Use pushrod operator with locking nut and butt hinges assembly.

F. Provide opposed-blade volume dampers with an appropriate control device in each of the following locations:
   1. Return air ductwork
   2. Outside air branch duct
   3. Exhaust branch duct
   4. Exhaust connections to hoods except kitchen grease hoods or equipment
   5. In each zone at multi-zone unit discharge installed downstream of duct mounted re-heat coils
   6. At each outside air and return air duct connection to plenum of constant volume units
   7. At discharge side of constant volume boxes
   8. Where otherwise indicated or required for balancing coordinate location of additional dampers required by TAB Contractor.
   9. Provide multi-blade dampers when blade width exceeds 12". Provide end bearing where damper shaft penetrates duct wall.

G. Elbows:
   1. Rectangular: Where square elbows are shown, or are required for good airflow, provide and install single-wall or airfoil turning vanes. Job-fabricated turning vanes, if used, shall be single-thickness vanes of galvanized steel sheets of the same gauge metal as the duct in which they are installed. Furnish vanes fabricated for the same angle as the duct offset. The use of radius elbows with a centerline radius of not less than 1-1/2 times the duct width may be provided in lieu of vaned elbows where space and air flow requirements permit.
   2. Round Oval Duct. Provide elbows with a centerline radius of 1-1/2 times the duct diameter or duct width. For round ducts, furnish smooth elbows or 5 piece, 90° elbows and 3 piece, 45° elbows.

H. For control devices concealed by ceilings, furring, or in other inaccessible locations, furnish extension rods and appropriate recessed-type Young regulators, mounted on the surface of the ceiling or the furring, unless specified, or shown otherwise. Provide with chrome plated cover plates. Use only one mitered gear set for each control device.

I. Install streamline deflectors at any point where dividing a sheet metal duct around piping or where other such obstruction is permitted. Where such obstructions occur in insulated ducts, fill space inside streamliner and around obstructions with glass fiber insulation.

J. Insulated Flexible Duct:
   1. Install in accordance with manufacturer's instructions, and the terms of its UL listing. Duct shall not exceed 6' in length. Make connections by use of sheet

metal collars and stainless steel circular screw clamps. Clamps shall encircle the duct completely and be tightened with a worm gear operator to the point that will provide an airtight connection without unnecessary deformation of the duct. Provide one clamp on flexible duct and one clamp on external insulation. Vapor barrier jacket shall be tucked inside to conceal insulation material.

2. Construct bends over 45° with sheet metal elbows.

K. Duct Supports:

1. Horizontal ducts up to 40". Support horizontal ducts up to and including 40" in their greater dimension by means of #18 U.S. gauge galvanized iron strap hangers attached to the ducts by a minimum of two locations per side by means of screws, rivets or clamps, and fastened to inserts with toggle bolts, beam clamps or other approved means. Place supports on at least 8' centers. Use clamps to fasten hangers to reinforcing on sealed ducts.
2. Horizontal ducts larger than 40". Support horizontal ducts larger than 40" in their greatest dimension by means of hanger rods bolted to angle iron trapeze hangers. Place supports on at least 8' centers in accordance with SMACNA Standards.
3. Support vertical ducts where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to 60". Above 60", the angles shall be increased in strength and sized on an individual basis considering space requirements.
4. Supports shall be suspended from structural or by independent support. Do not support from structural bridging. Upper attachments should be selected with a safety factor of 4 or 5 times actual load conditions and subject to Engineers approval. Double wrap straps over open web of joist.

L. Branch connections for medium pressure ductwork shall be made with a conical lateral. Field installed conical branch ducts shall be minimum 20-gauge galvanized sheet metal, “Everdur” welded and coated with “Galvabar”.

3.3 PLENUMS

A. Return air plenums shall be rectangular galvanized sheet metal ductwork.

B. Fabricate plenums upstream of fan of 16-gauge material.

C. Fabricate plenums upstream of filters minimum 18-gauge material.

3.4 FLEXIBLE CONNECTIONS

A. Where ducts connect to fans or air handling units that are not internally isolated, make flexible airtight connections using "Ventglas" fabric. The fabric shall be fire-resistant, waterproof and mildew resistant with a weight of approximately 30 ounces per square yard. Provide a minimum of 1/2" slack in the connections, and a minimum of 2-1/2" distance between the edges of the ducts. Also, provide a minimum of 1" slack for each inch of static pressure on the fan system. Fasten fabric to apparatus and to adjacent ductwork by means of galvanized flats or draw bands. Where connections are made in outdoor locations, seal fabric to metal with mastic.

3.5 DUCT LINING

A. Install glass fiber acoustical lining where shown on drawings. Secure to duct surfaces with Foster 85-62 / 85-60 or Childers CP-125-1 / CP-127 adhesive and sheet metal fasteners on 12" centers. Coat exposed edges and leading edges of cross-joints with adhesive.

B. Provide metal nosing that is either channeled or "Z" profiled or are integrally-formed from

the duct wall securely installed over transversely oriented liner edges facing the air stream at fan discharge and at any interval of lined duct preceded by unlined duct.

C. Refer to Insulation & Liner Detail on drawings for locations requiring liner to be installed.

D. Do not install liner in multi-zone unit ductwork.

3.6 SEALING OF SEAMS AND JOINTS

A. Seal supply, return, exhaust and outside air duct systems.

3.7 FLUES

A. Provide and install flues for all gas fired equipment.

B. Refer to plans for all related locations.

C. Contractor is responsible for coordinating stack sizing, stack drains, stack test ports, stack termination fittings and all other required fittings with the selected equipment manufacturers.

D. All fittings and accessories shall be manufactured by the flue manufacturer. The flue shall be installed per manufacturer's instruction.

E. Terminate flues at height above roof to prevent flue gas from entering the building.

3.8 CONNECTIONS TO LOUVERS

A. Make watertight connections to all louvers. Ductwork behind louver shall have watertight soldered joints for a minimum of three feet and be sloped to bottom of louver. Lap duct to be over bottom louver blade where possible.

B. Where plenums are installed on inside of louver, construct such that bottom of plenum will lap over bottom blade of louver to drain any water that may enter.

3.9 PLENUMS

A. Construct plenums with galvanized steel framing members and galvanized sheet steel, cross broken and rigidly braced with galvanized angles. Gauges and bracing shall conform to SMACNA recommendations for ductwork of like sizes. Openings for fans, access doors, etc., shall be framed with galvanized steel angles.

B. Provide access doors.

3.10 AUXILIARY DRAIN PANS

A. Where coils that have a condensate drain are located above ceiling.

3.11 TESTING OF LOW PRESSURE DUCTWORK

A. Test ductwork for leaks before concealing. Maximum allowable leakage is 5% of total airflow.

B. Provide equipment necessary for performing tests, including rotary blower large enough to provide required static pressure at allowed CFM quantity, certified orifice section with

proper papers, traceable serial numbers and pressure vs CFM leakage rate scale, U-tube gauge board complete with cocks, tubing, and inclined manometer for leakage rates.

C. Mains: Test mains after risers and branches are tied in and all equipment set. Close runout connections and place fan in operation. Provide pressure in mains at 1-1/2 times design pressure. Visually inspect joints. Repair leaks detected by sound or touch. Release mains for completion after joints are tight.

D. Ductwork down stream of terminal boxes, return, exhaust, and outside air ducts are to be visually inspected.

END OF SECTION

SECTION 23 34 16

FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install fans, including centrifugal, axial and propeller types, with supplemental equipment.

1.2 RELATED WORK

A. Division 23 Mechanical:
   1. Ductwork.
   2. Vibration Isolation.
   3. Air Balance.
   4. Electrical Provisions of Mechanical Work.

1.3 PERFORMANCE

A. Provide fan type, arrangement, rotation, capacity, size, motor horsepower, and motor voltage as shown. Fan capacities and characteristics are scheduled on the drawings. Provide fans capable of accommodating static pressure variations of +10% of scheduled design at the design air flow.

B. Rate fans according to appropriate Air Moving and Conditioning Association, Inc. (AMCA), approved test codes and procedures. Supply fans with sound ratings below the maximums permitted by AMCA Standards. All fans provided must be licensed to bear the Certified Ratings Seal.

C. Statically and dynamically balance all fans.

D. Motors shall be sized so that they do not operate within the motor service factor.

E. Fans shall be capable of 120% of the scheduled air capacities.

F. All static pressures shown on schedules are external to fans. Manufacturer shall add damper and accessory losses to scheduled value before selecting fan.

1.4 SUBMITTALS

A. Submit fan performance curves with system operating point plotted on curves.

B. Submit manufacturer’s printed installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cook.

B. Greenheck.

C. Penn Barry Ventilator.

D. Twin City Fans

2.2 SUPPLEMENTAL EQUIPMENT

A. Motor Covers. Provide weatherproof motor covers for installations out of doors. Apply the same finish as used on the fan.

B. Belt Drives:
1. Unless otherwise specified for belt-driven fans, equip the fan motors with variable pitch sheaves. Select the sheave size for the approximate midpoint of adjustment and to provide not less than 20% speed variation from full open to full closed. Size drives for 150% of rated horsepower. Key the fan sheave to the fan shaft.
2. Nonadjustable motor sheaves may be used for motor sizes over 15 horsepower, at the Contractor's option. However, if changing a nonadjustable sheave becomes necessary to produce the specified capacity, the change must be made at no additional cost.
3. Provide belt guards and apply the same finish as used on the fan.
4. Oil and heat resistant, nonstatic type belts.
5. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty, regreasable, ball type, in a pillow block, cast iron housing, selected for a minimum L50 life in excess of 200,000 hours at maximum catalog operating speed.

C. Safety Disconnect Switch: Provide a factory-wired to motor, safety disconnect switch on each unit.

D. Relief Vents and Air Inlets: Provide vents and inlets with aluminum frames and 1/2" mesh, galvanized bird screens. Include dampers where shown.

E. Prefabricated Roof Curbs: Furnish prefabricated roof curbs as detailed. The minimum height is 14". Include a resilient pad on each roof curb so the equipment can be mounted on the top flange for proper seal. Coordinate roof slope and curb to ensure equipment is installed in level position. Provide double shell to protect insulation from damage.

F. Dampers. Where automatic backdraft damper is scheduled:
1. Multi-bladed.
2. Heavy duty.
3. Roll formed aluminum blades.
4. Nylon bearings.
5. Neoprene weather strip on blade edge.

G. All fans are to be provided with a durable, deep etched, .025" thick, factory installed aluminum identification plate with the following information. Plates are to be furnished with four mounting holes.
1. Fan mark as indicated on the Contract Drawings.
2. Serial number.
3. Model number.
4. Capacity (CFM) and static pressure.
5. Motor HP.
6. Motor Amps.
7. Manufacturer.
8. Motor phase.
9. Number of Belts/Make/Size.
10. Motor volts.

I. Utility Vent Set Fans, provide minimum ¾ inch threaded coupling drain connection at

lowest point of housing.

2.3 VENTILATION AND EXHAUST FANS

A. Provide the ventilation and exhaust fans shown on the drawings.

B. Provide each motor with internal overload protection.

C. Provide each belt driven fan with approved, totally enclosed belt guard.

D. Provide approved safety screen where inlet or outlet is exposed.

E. Provide duct flanges where required for connections.

F. Furnish kitchen hood exhaust fans with vented curb extension that meets NFPA 96, cleanout port, grease tap, curb seal, drain connection and hinge kit.

G. Furnish supply fans with 1” aluminum, washable filter section.

2.4 ROOFTOP VENTILATION AND EXHAUST SYSTEMS

A. Provide the rooftop ventilation and exhaust systems shown on the drawings.

B. Provide each motor with internal overload protection.

C. Components:
1. Aluminum, stainless steel or plastic coated bird guard.
2. Screws and fasteners of stainless steel or nonferrous material.
3. All aluminum construction unless indicated otherwise on fan schedule.

D. Welded construction, corrosion resistant fasteners, minimum 16 gauge marine allow aluminum.

E. Aluminum base shall be continuously welded curb cap corners.

2.5 GRAVITY ROOF-TOP INTAKE AND RELIEF VENTS

A. Provide the rooftop intake and relief vent systems shown on the drawings.

B. Provide with aluminum, stainless steel or plastic coated bird guard.
1. Screws and fasteners of stainless steel or nonferrous material
2. All aluminum construction

C. Welded construction, corrosion resistant fasteners, minimum 16-gauge marine alloy aluminum.

D. Aluminum base shall be continuously welded curb cap corners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fans according to the manufacturer's instructions and in the locations shown on the drawings. Ensure fan location is installed at minimum distance from roof edge to meet code requirements.

B. Do not operate fans or fan powered devices for any purpose until ductwork is clean, filters in place, bearings lubricated and the fan has been run under observation.

C. Roof mounted fans and gravity roof-top intake and relief vents shall be secured to the curb with stainless steel lag screws at a minimum of 6-inches on center. Follow manufacturer's installation instructions if they are more stringent. Install roof mounted equipment in a level position. Units shall be seated on properly sized curb. Gap between base of the fan and top of the curb shall be sealed with neoprene 1" x ¼" gasket. Gasket shall be glued or attached with pressure sensitive adhesive.

D. Install curbs and equipment in level position.

E. Ceiling mounted in-line centrifugal blowers
   1. Shall be suspended from structure with 1/2-inch zinc plated all-thread rods secured to structure.
   2. Provide sub-structure where required.
   3. Mount bottom of fan no more than 18-inches above the finished ceiling height.

3.2 EXTRA MATERIALS

A. Provide two sets of belts for each fan, not including the set installed on the fans. Tag set to identify fan.

END OF SECTION

SECTION 23 37 13

AIR DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install air distribution devices, including grilles, diffusers, registers, dampers, and extractors.

1.2 RELATED WORK

A. Division 23 Mechanical.
   1. Ductwork.
   2. Air Balance.
   3. Electrical Requirements for Mechanical Work.

1.3 COOPERATION WITH OTHER TRADES

A. Coordinate this work with work under Division 26 Electrical, to ensure that intended functions of lighting and air systems are achieved.

1.4 SUBMITTALS

A. Submit product data for outlets, grilles, registers, control devices, and similar equipment for review prior to placement of purchase order.

B. Submittal shall include performance sheet for each air device type. Performance sheet shall include NC levels, throw, and total pressure loss at various air flows.

1.5 FINISHES

A. Paint exposed devices with factory standard prime coat, or factory finish coat, as specified.

PART 2 - PRODUCTS

2.1 DIFFUSERS, GRILLES AND REGISTERS - Refer to Drawing Schedule.

2.2 ACCEPTABLE MANUFACTURERS

A. Titus.

B. Krueger.

C. Nailor Industries.

D. Price.

E. Metal-Aire.

2.3 ACCESSORIES

A. Supply Grille Extractors. Provide supply grilles with an air control device capable of positively regulating the volume of air extracted from the supply duct.

Select extractors similar to Titus Model AG25, tight-closing in the minimum position. Include a key-operated or worm-gear adjusting mechanism to facilitate positioning from the grille opening. Where adjustment is not accessible at the grille opening, provide a square control rod equipped with a locking quadrant.

B. Mounting Frames. Provide each grille or register not equipped with a removable core with a companion, all-purpose mounting frame constructed like grille frame to facilitate installation and removal of the grille or register without marring adjacent mounting surfaces.
   1. Furnish frames with 1/2" thick sponge rubber gasket to prevent air leakage.
   2. Provide a frame that neatly fits the grille. Mounting frames will not be required for grilles or registers mounted directly on exposed ductwork.

PART 3 - EXECUTION

3.1 INSPECTION

A. Do not install ceilings adjacent to fixtures until installation of fixtures, air supply assemblies, return-air blank-off strips and flexible duct have been approved. Remove and reinstall any part of the installation found incorrect.

3.2 INSTALLATION

A. Louvered diffuser outlets mount tight against the ceiling. Fasten outlets to ductwork with sheet metal screws. For perforated diffusers, attach the frame assembly by a concealed hinge assembly to an outer frame compatible with the type of ceiling on which the diffuser is installed.

END OF SECTION

SECTION 23 63 00

AIR-COOLED CONDENSING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install air-cooled condensing units complete with casing, compressor, condenser coil, condenser fan and controls required for a split air conditioning system.

1.2 RELATED WORK

A. Refrigerant Piping.

B. Electrical Provisions of Mechanical Work.

1.3 PERFORMANCE

A. Provide performance as scheduled on drawings, and head pressure control to enable unit to operate in temperatures as low as 20 degrees F. ambient.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier.

B. Trane.

C. Daikin.

D. York.

E. Lennox.

2.2 COMPRESSOR

A. Provide a hermetic or semi-hermetic compressor with crankcase heaters, inherently protected motors, spring mounts and capacity modulation. Provide each compressor with a 5-year warranty.

2.3 CONDENSER COILS

A. Provide copper tubes with mechanically bonded aluminum fins. Protect condenser coils with a heavy gauge, corrosion resistant wire guard.

2.4 FANS AND MOTORS

A. Provide propeller-type fans with direct drive or belt drive and vertical discharge. Protect fan with a heavy-gauge, corrosion resistant wire guard. Provide inherently protected, permanently lubricated, and weatherproof motors.

2.5 CASING

A. Furnish a unit designed for outdoor mounting. Fabricate the casing of heavy gauge steel, zinc coated and finished with enamel. Provide removable access panels.

2.6 CONTROLS

A. Provide safety and operating controls factory wired and mounted in a separate enclosure. Include thermostatic expansion valve, high and low pressure switches and compressor motor overload devices. Furnish a time delay device to prevent short cycling. Employ a control transformer, a pressure relief device and suction and discharge valves with service connections.

2.7 THERMOSTAT

A. Low voltage, 7-day programmable thermostat is a component of the unit manufacturer unless specified in another Section.
   1. Individual Heating/Cooling setpoints.
   2. Automatic Heat/Cool change-over.
   3. Sub-Base On-Off-Auto fan selection.
   4. Sub-Base Heat-Off-Cool-Auto system selection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount condensing units on 4" foundation pads and pipe as shown on Drawings or as recommended by the equipment manufacturer. Install removable core refrigerant filter dryer and sight indicating glass.

3.2 CONTROL WIRING

A. Furnish and install control wiring as required. Install control wiring in conduit.

END OF SECTION

SECTION 23 81 21

SINGLE PACKAGE ROOFTOP AIR CONDITIONERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide and install a single-package, single-zone, electric air conditioner with gas-fired heat for rooftop application.

1.2 RELATED WORK

A. Division 23 Mechanical.
   1. Ductwork.
   2. Air Balance.
   3. Electrical provisions for mechanical work.
   4. Air Filtration.

1.3 PERFORMANCE

A. As scheduled on drawings, with head pressure control to enable unit start and operate down to 20 degrees F ambient.

1.4 SUBMITTALS

A. Manufacturer’s certified capacity data.

B. Submit manufacturer’s installation, start-up and service instructions.

C. Submit recommended clearance dimensions for air flow and service.

D. Submit coordination drawings as specified. Consideration shall be given to adjacent structures and their effect on air flow patterns.

E. Submit internal wiring diagram of Control Center.

F. Submit sequence of operation in narrative form.

G. Mark-up a copy of the specifications indicating in the margin of each paragraph the following: COMPLY, DO NOT COMPLY, NOT APPLICABLE.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier.

B. York.

C. Lennox.

2.2 COMPRESSOR

A. Provide a thermally protected, serviceable semi-hermetic compressor or hermetic

compressor with service valves, vibration isolation, crankcase heaters, slight glass and filter drier. Provide with a 5 year warranty.

2.3 EVAPORATOR AND CONDENSER COILS

A. Provide copper tubes with mechanically bonded aluminum fins for evaporator and condenser coils.

B. Provide hail guards for condenser coils.

2.4 EVAPORATOR FANS

A. Provide a belt-driven, forward-curved, centrifugal evaporator fan, with adjustable motor sheaves. Motor shall contain permanently lubricated bearings. Provide motor HP as indicated on the drawings.

2.5 GAS HEATING SECTION

A. Unit shall be equipped with corrosion resistant burners and heat exchangers.

B. Gas Controls.
1. Automatic gas valve and pressure regulator.
2. A manual shutoff valve.
3. Pilot valve.
4. Two flame rollout limit switches.
5. An adjustable fan control.
6. Fixed high limit controls

C. Unit shall be equipped with an electric spark pilot ignition system.
1. Electronic flame detection.
2. 100% safety shutoff.

D. Combustion air shall be induced by a positive pressure power venting fan.
1. Prepurge of combustion chamber.

E. Furnish through-the-bottom electrical service connection.

2.6 CASING FILTERS AND DUCT CONNECTION

A. Provide a cabinet constructed of galvanized or zinc-coated steel, primed and coated with baked enamel and suitable for outdoor installation.

B. Provide duct connections on the bottom of each unit, as indicated on drawings.

C. Provide manually operated outdoor air dampers.

D. Furnish 2" thick filters as specified.

E. Furnish through-the-bottom electrical service connection.

2.7 ROOF CURB

A. Install a roof curb of the same manufacture as the air conditioning unit.
1. Curb to support the unit and provide a watertight enclosure to protect ductwork and utility services.

2. Use a design complying with National Roofing Contractors Association requirements.
3. Level curb according to manufacturer's recommendations.
4. The assembly of the unit and roof curb shall be rated for 150 MPH winds. Provide engineered drawings certifying this requirement is met.

2.8 OUTDOOR FANS

A. Provide propeller type with direct-driven permanently lubricated motor. Fan shall discharge upward.

2.9 THERMOSTAT ASSEMBLY

A. Provide staged heating and cooling as required, automatic changeover and fan control.

2.10 HEAD PRESSURE CONTROL

A. Provide solid state outdoor air fan speed control to permit unit to operate down to -20°F.

2.11 SHORT CYCLE CIRCUIT

A. Provide circuit to prevent compressor from short cycling as a result of a rapid change in thermostat setting. Circuit also prevents compressor restart at least 5 minutes after shutdown.

2.12 CONVENIENCE OUTLET

A. Provide 115 volt outlet in unit cabinet.

2.13 MOTORIZED OUTSIDE AIR DAMPER

A. Low leakage 14-gauge galvanized steel.
1. Airfoil Blades.
2. Ruskin CD60.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install according to manufacturer's recommendations and as shown on drawings.

B. Unit is to be provided with a through-the-bottom service connection accessory package and must be used for electrical connections to unit. Use bulkhead connectors to make a waterproof connection.

C. Seal all duct connections to roof curb for air tight connection. Install a 90 degree flanged ductwork connection to the roof curb. Provide and install gasketing around duct flanges. Provide and install gasketing around outer edge of roof curb.

3.2 STARTUP

A. Provide the services of a factory trained service technician employed full time by the unit manufacturer to start-up the system, or manufacturer's factory authorized representative under the supervision of the factory trained service technician. Upon completion of the installation, the system shall be started and commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system. The factory

authorized representative will verify that accessories are installed and performing the specified functions. (Contractor startup is unacceptable.)

B. The attached written startup report shall be provided to the owner and engineer upon completion.

END OF SECTION

SECTION 23 82 19

FAN COIL UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Floor mounted decorative cabinet fan/coil units, horizontal fan/coil units for concealed installation and horizontal exposed ceiling mounted fan/coil units with decorative cabinet.

1.2 RELATED WORK

A. Division 23 Mechanical
   1. Air Balance.
   2. Controls.
   3. Electrical Provisions of Mechanical Work.
   4. Ductwork.
   5. Air filtration.

1.3 REFERENCES

A. ANSI/AHRI 410 - force circulation air cooling and air heating coils.

B. National Electrical Code.

1.4 SUBMITTALS

A. Submit manufacturer's dimensioned product data sheets.
   1. Show location of filter access doors.

B. Submit fan performance curve for each unit:
   1. Plot fan volume against static pressure, horsepower and efficiency.
   2. Show point of rating based on static requirements of the system.

C. Submit the fan performance plot at each motor speed position with consideration for the reduced internal static.

D. Submit a chart of specific sound power level at each octave band center frequency.

E. Submit manufacturer's certified heating and cooling coil capacity data.

F. Submit filter manufacturer's product data sheets and capacity information.

G. Submit manufacturer's data on housing insulation material.

1.5 CAPACITY

A. Refer to equipment schedule.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Trane.

B. Daikin.

C. York.

2.2 COMPONENTS

A. Fan section.

B. V-belt drive assembly, or,.

C. Multi-speed direct connected motor.

D. Filter section.

E. Coil section.

F. Insulated sheet metal cabinet with removable panels for access to the interior.

G. Motor and drive inside the cabinet.

2.3 FAN SECTION

A. Locate the motor and drive assembly inside the cabinet.

B. Size each v-belt drive for 50% overload.
   1. Adjustable pitch motor pulley.
   2. Provide built-in motor protection.
   3. Belt adjustment means.

C. Provide multi-speed direct connected fan motor with built-in motor protection.
   1. Three-speed windings.
   2. Factory wired to a junction box with provisions for motor speed change, mounted on the box.
   3. Resiliently mounted.

D. Select the fan motor so that the brake horsepower required to deliver the design air quantity at the system static pressure will not exceed the motor nameplate amperage rating.

E. Supply Fans:
   1. Double width, double inlet, forward curve blade.
   2. Statically and dynamically balanced.
   3. Tested after being installed in the fan section.
   4. Selected for the design air quantities and static pressure of the system.
   5. Mounted on a common shaft if multiple wheels.

F. Select fan to operate at or near its maximum efficiency point when handling the required air quantity and static pressure.

G. Fan Bearings:
   1. Permanently lubricated.
   2. Self-aligning.

2.4 UNIT HOUSING

A. Construct the unit of galvanized steel sheets, and formed members.
   1. Provide structure to brace the assembly for the pressure of the system.

B. Bolt housing components together with neoprene gasketed airtight joints.

C. Internally insulate the entire unit with neoprene coated, 1-1/2 lb. density glass fiber insulation, applied to internal surfaces with adhesive and weld pins. Coat exposed edges of insulation with adhesive.

D. Insulation, vapor barriers, facings and adhesives:
   1. Flame spread not higher than 25.
   2. Smoke developed rating not higher than 50.

E. Condensation on the exterior of the unit is not approved.

F. Provide a duct flange on four sides of the return air inlet and supply air outlet of the unit.
   1. Sized to permit connection of the flexible connection to the ductwork.
   2. Extend beyond the primary drain pan.
   3. Minimum dimension 2".

G. Provide insulated, removable panels for access to the interior.
   1. Plated captive screws and nuts.
   2. Neoprene gaskets.

2.5 CONDENSATE DRAIN PANS

A. IAQ style drain pans shall be provided under all coils.
   1. Pitch to drain connection.
   2. Fabricated from 16 gauge 304 stainless steel.
   3. Triple pitched for complete drainage with no standing water.
   4. Insulated to prevent condensation.
   5. Welded corners.
   6. Stainless drain connection.

2.6 COILS

A. Reference Schedule and Specification Section 23 82 16.

2.7 FILTER SECTION

A. Locate behind access doors.
   1. Construct with substantial hinges.
   2. Neoprene gaskets.
   3. Permanent quick-release latching devices.

B. Arranged to accommodate the 1" thick filters as specified.
   1. Single section filter.

C. Provide full length tracks to support the filter.

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Provide the following spare parts and material to the Owner for use after the warranty period.
   1. One spare fan motor for each size of fan motor on the project.
   2. One spare set of filters or filter media for each fan coil unit on the project.

3.2 ELECTRICAL REQUIREMENTS

A. Bring electrical connections to a common junction box.

3.3 STORAGE

A. Storage and shipping in accordance with manufacturer's recommendations.

3.4 INSTALLATION

A. Install unit so motor connections and filters are accessible.

END OF SECTION

SECTION 26 05 00

ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Except as modified in this Section, General Conditions, and Supplementary Conditions, applicable provisions of Division 1 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 26 Electrical.

B. Applicable provisions of this section apply to all sections of Division 26, Electrical.

1.2 CODE REQUIREMENTS AND FEES

A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.

B. Electrical work shall comply with applicable inspection services:
1. Underwriters Laboratories.
2. National Fire Protection Association.
3. State Health Department.
4. Local Municipal Building Inspection Department adopted codes with amendments.
5. National Electrical Code with local amendments.
6. State Regulatory Agencies.
7. Where the project is located outside a municipal jurisdiction, and has no municipal inspection services, the National Electrical Code with amendments of the municipality with extraterritorial jurisdiction shall govern.
8. Where the project is located outside any municipal jurisdiction, including extraterritorial jurisdictions, the National Electrical Code with local adopted amendments of the largest municipality located in the same county or parish shall govern.
9. International Energy Conservation Code.
10. National Electrical Safety Code.

C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.

D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.

E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:
1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, APWA, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date proposals are received. Referenced specifications and standards are minimum requirements for all equipment, material and work. In instances where specified capacities, size or other features of equipment, devices or materials exceed these minimums, meet specified capacities.

B. Use electrical materials and equipment that is constructed and tested in accordance with the standards of NEMA, ANSI, ASTM, or another recognized commercial standard. If materials and equipment is labeled, listed, or recognized by any Nationally Recognized Testing Laboratory (NRTL) acceptable to the Occupational Safety and Health Administration (OSHA), then provide NRTL-labeled, listed, or recognized material and equipment. Acceptable NRTLs include but are not limited to:
   1. Underwriters Laboratories, Inc. (UL)
   2. Factory Mutual Research Corp. (FMRC) (also referred to as “Factory Mutual Global,” or “FM Global”)
   3. Intertek Testing Services NA, Inc. (ITSNA, formerly ETL)
   4. Canadian Standards Association (CSA)
   5. A complete listing of acceptable NRTLs is published on the OSHA website at http://www.osha.gov/dts/otpca/nrtl/.

C. Where material and equipment are not labeled, listed, or recognized by any NRTL, provide a manufacturer’s Certificate of Compliance indicating complete compliance of each item with applicable standards of NEMA, ANSI, ASTM, or other recognized commercial standard.

D. Do not install or use electrical material or equipment for any use other than that for which it was designed, labeled, listed, or identified unless formally approved for such use by the Owner’s AHJ. This *National Electrical Code*® requirement is re-stated for emphasis.

E. Codes and Standards applicable to this Division:
   1. ANSI – American National Standards Institute
      a. ANSI Z535.1, Safety Colors
      b. ANSI Z535.2, Environmental and Facility Safety Signs
      c. ANSI Z535.3, Criteria for Safety Symbols
      d. ANSI Z535.4, Product Safety Signs and Labels
   2. ASHRAE – American Society of Heating, Refrigeration, and Air Conditioning Engineers:
      a. ASHRAE Standard 90.1, *Energy Standards for Buildings Except for Low Rise Residential Buildings [ANSI, IESNA]*
   3. ASTM – American Society for Testing and Materials
   4. CBM – Certified Ballast Manufacturers
   5. ICC – International Code Council
      a. International Building Code® (IBC)
      b. International Existing Building Code® (IEBC)
   6. ICEA – Insulated Cable Engineers Association
      a. ICEA S-93-639, *Shielded Power Cables 5-46kV* (NEMA WC-74)
   7. IEEE® - Institute of Electronics and Electrical Engineers
      a. IEEE C2™, *National Electrical Safety Code* (NESC) [ANSI]
      b. IEEE Std 141™, *Recommended Practice for Electric Power Distribution for Industrial Plans* (“Red Book”)
      c. IEEE Std 143™, *Recommended Practice for Grounding of Industrial and Commercial Power Systems* (“Green Book”)

d. IEEE Std 241™, *Recommended Practice for Electric Power Systems in Commercial Buildings* (“Gray Book”)
e. IEEE Std 242™, *Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems* (“Buff Book”)
f. IEEE Std 315™, *Graphic Symbols for Electrical and Electronics Diagrams*
g. IEEE Std 399™, *Recommended Practice for Power Systems Analysis* (“Brown Book”)
h. IEEE Std 446™, *Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications* (“Orange Book”)
i. IEE Std 493™, *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems* (“Gold Book”)
j. IEEE Std 519™, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*
k. IEEE Std 739™, *Recommended Practice for Energy Management in Industrial and Commercial Facilities* (“Bronze Book”)
l. IEEE Std 902™, *Guide for Maintenance, Operation, and Safety of Industrial and Commercial Power Systems* (“Yellow Book”)
m. IEEE Std 1015™, *Recommended Practice Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems* (“Blue Book”)
n. IEEE Std 11oo™, *Recommended Practice for Powering and Grounding Electronic Equipment* (“Emerald Book”)
o. IEEE Std 1584™, *Guide for Performing Arc-Flash Hazard Calculations*

8. IESNA – Illuminating Engineering Society of North America
   a. IESNA *Lighting Handbook*, Ninth Edition
   b. IESNA RP-1, *American National Standard Practice for Office Lighting*
   c. IESNA RP-7, *American National Standard Practice for Lighting Industrial Facilities*
9. NECA – National Electrical Contractors Association:
   a. NECA 1, *Good Workmanship in Electrical Construction* [ANSI]
   b. NECA 90, *Recommended Practice for Commissioning Building Electrical Systems* [ANSI]
   c. NECA 100, *Symbols for Electrical Construction Drawings* [ANSI]
   d. NECA 101, *Standard for Installing Steel Conduits (Rigid, IMC, EMT)* [ANSI]
   e. NECA 104, *Recommended Practice for Installing Aluminum Building Wire and Cable* [ANSI]
   f. NECA / NEMA 105, *Recommended Practice for Installing Metal Cable Tray Systems* [ANSI]
   g. NECA 111, *Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)* [ANSI]
   h. NECA / NACNA 120, *Standard for Installing Armored Cable (Type AC) and Metal-Clad Cable (Type MC)* [ANSI]
   i. NECA 202, *Recommended Practice for Installing and Maintaining Industrial Heat Tracing Systems* [ANSI]
   j. NECA 230, *Standard for Selecting, Installing and Maintaining Electric Motors and Motor Controllers* [ANSI]
   k. NECA 331, *Standard for Building and Service Entrance Grounding and Bonding*
   l. NECA 400, *Standard for Installing and Maintaining Switchboards* [ANSI]
   m. NECA 402, *Standard for Installing and Maintaining Motor Control Centers* [ANSI]
   n. NECA / EGSA 404, *Standard for Installing Generator Sets* [ANSI]

o. NECA 407, *Recommended Practice for Installing and Maintaining Panelboards* [ANSI]
p. NECA 408, *Recommended Practice for Installing and Maintaining Busways* [ANSI]
q. NECA 409, *Recommended Practice for Installing and Maintaining Dry-Type Transformers* [ANSI]
r. NECA 410, *Recommended Practice for Installing and Maintaining Liquid-Filled Transformers* [ANSI]
s. NECA 411, *Recommended Practice for Installing and Maintaining Uninterruptible Power Supplied (UPS)* (ANSI]
t. NECA 420, *Standard for Fuse Applications* [ANSI]
u. NECA 430, *Standard for Installing Medium-Voltage Metal-Clad Switchgear* [ANSI]
v. NECA / IESNA 500, *Recommended Practice for Installing Indoor Lighting Systems* [ANSI]
w. NECA / IESNA 501, *Recommended Practice for Installing Exterior Lighting Systems* [ANSI]
x. NECA / IESNA 502, *Recommended Practice for Installing Industrial Lighting Systems* [ANSI]
y. NECA / MACSCB 600, *Recommended Practice for Installing and Maintaining Medium-Voltage Cable* [ANSI]
z. NECA / NEMA 605, *Installing Underground Nonmetallic Utility Duct* [ANSI]

10. NEMA – National Electrical Manufacturers Association
11. NETA – International Electrical Testing Association, Inc.:
    a. NETA ATS, *Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems*
    b. NETA MTS, *Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*
    c. NETA ETT, *Standard for Certification of Electrical Testing Technicians* [ANSI]
12. NFPA – National Fire Protection Association:
    a. NFPA 20®, *Standard for the Installation of Stationary Pumps for Fire Protection*®
    b. NFPA 70 ™, *National Electrical Code® (NEC®)*
    c. NFPA 70E, *Standard for Electrical Safety in the Workplace.*
    d. NFPA 101®, Life Safety Code®
    e. NFPA 110, *Standard for Emergency and Standby Power Systems*
    f. NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*
    g. NFPA 780, *Standard for the Installation of Lightning Protection Systems*
    h. All other NFPA codes and standards except NFPA 5000
13. OSHA – Occupational Safety and Health Administration
14. IECC – International Energy Conservation Code
15. ISO – International Organization for Standardization
16. State and Local Energy Conservation Code
17. Applicable County and Municipal Codes

1.5 CONTRACT DRAWINGS

A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

B. Every effort has been made by the Engineer to indicate wiring of all receptacles, light fixtures, switches, telephone outlets, HVAC equipment, other equipment, elevator equipment, and all other devices / appliances requiring electrical power. It is the intent of

the Engineer that all light fixtures be powered and controlled unless specifically noted on the plans; that all wiring devices (receptacles and direct connected equipment) be circuited to a power source of the correct voltage and that all HVAC, elevator equipment and other equipment be properly wired to the correct voltage power source; that all communications and security systems devices and equipment and all fire alarm system devices and equipment are installed, wired and systems are fully operational.

C. It is the responsibility of the Contractor to review the construction drawings (reflected ceiling plans) for light fixtures, casework elevation details for electrical devices which are not indicated on the electrical drawings; to review the mechanical and plumbing documents and all other drawings to determine the electrical rough-ins for all equipment requiring power connections, and to include in their proposals the correct and complete electrical rough-ins for all of these items which were inadvertently not indicated on the electrical drawings, OR the Contractor shall specifically enumerate each item requiring electrical rough-in which is not specifically shown on the electrical drawings, and indicate the electrical provisions of these items as specifically excluded from his proposal.

D. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.

E. No proposal shall be accepted which specifically excludes any of the provisions of paragraphs B, C, or D above.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and under slab service and feeders installed, dimensioning exact location and elevation of such installations.

B. At conclusion of project, obtain without cost to the Owner, electronic PDF and AutoCAD 2014 and / or Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: “2 sets of CDs and prints for Owner’s use, one set of CDs, prints, and mylars for Architect / Engineers Records”. Delivery of these as-built electronic, reproducibles and prints is a condition of final acceptance.
   1. 3 sets of electronic AutoCAD (2014 dwg) and / or Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
   2. One reproducible Dayrex Mylar film positive of each contract as-built drawing.
   3. Three sets of blue-line prints of each contract as-built drawing.
   4. Three sets of pdf prints of each contract as-built drawing on CD.

C. As-Built Drawings should indicate the following information as a minimum:
   1. Indicate all addendum changes to documents.
   2. Remove Engineer’s Seal, name, address, and logo from drawings.
   3. Mark documents RECORD DRAWINGS.
   4. Clearly indicate: DOCUMENT PRODUCED BY:
   5. Indicate all changes to construction during construction. Indicate actual routing of all conduits, etc. that was deviated from construction drawings.

6. Indicate exact location of all underground electrical raceways, and elevations.
7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
9. Exact location of all electrical equipment in building. Label panel schedules to indicate actual location.
10. Exact location of all electrical equipment in and outside of the building.
11. Exact location of all outdoor lighting poles and equipment.
12. Location, size and routing of all feeder conduits, equipment, etc. shall be accurately and neatly shown to dimension.
13. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
14. Cloud all changes.
15. Update all panel schedules with all additional circuits added or deleted through construction. Identify each circuit to include all information specified for directory cards for circuit identification in panelboards.

1.7 SPACE REQUIREMENTS

A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.

B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.

C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.

D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.

E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.
   1. Make final electrical connections to all electrically operated equipment indicated on the drawings, except as noted.
   2. The responsibility for alignment of motor and driven equipment is specified in the related division.

F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.

G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.9 CONCEALED AND EXPOSED WORK

A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.10 GUARANTEE

A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. Replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

A. Manufacturers names and catalog number specified under sections of Division 26 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the Contract Documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed. Written notification of intent to use manufacturers other than those specified is required ten days prior to bid. Submittals shall be reviewed only after bidding and may be rejected if any aspect of the equivalent product is deemed lesser than that of the specified product by the specifier. The contractor shall be responsible for ensuring alternates are equivalent to those specified.. Submit a marked-up set of the relevant specification section indicating all variances, a comparison to the specified product, and of construction and performance criteria, complete design and performance data for the specified product and the proposed substitution for comparison to the Engineer. The Architect issues approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.

1.14 UTILITIES, LOCATIONS AND ELEVATIONS

A. Locations and elevations of the various utilities included within the scope of this work:
   1. Obtained from utility maps and other substantially reliable sources.
   2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.

B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.15 OPERATING TESTS

A. After all electrical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.16 WARRANTIES

A. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, normal freight / shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service calls required to diagnose and correct warranty problems.

B. Manufacturer’s warranty shall be from one year from date of substantial completion. Contractor shall be responsible for extending the warranties regardless of date of installation or commissioning.

C. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.17 BUILDING CONSTRUCTION

A. It shall be the responsibility of the sub-contractor to consult the Contract Drawings, details and specifications and thoroughly familiarize himself as to the construction and all job-related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager Job site superintendent and lay out work so that all raceways and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.18 TEMPORARY FACILITIES

A. General: Refer to Division 1 for general requirements on temporary facilities.

B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under this Division. Installation of temporary power shall be in accordance with NEC Article 527.

C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed by this Contractor at the completion of the Contract.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 IDENTIFICATION OF EQUIPMENT

A. Identification of Equipment:

1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions. All panels, cabinets, or equipment requiring 120 volt or higher power shall be labeled as required which includes circuit designation and circuit panelboard location, regardless of which discipline installs the equipment.
2. Three layer laminated plastic engraved identifying nameplate shall be permanently secured to each switchboard, distribution panel, motor control center, transformer, panelboard, safety disconnect switch, enclosed circuit breaker, transfer switches, remote generator transfer deices not installed inside light fixtures, wireway, busduct plug, terminal cabinet, surge protective device, capacitor, individual motor controller, contactor, fire alarm panels (main and remote booster), and communications (voice, data, video) cabinet or rack, security panels, time clocks, BMCS cabinets, sound reinforcement cabinets and racks, miscellaneous control cabinets, equipment integral disconnect switches, toggle or motor switches, disconnects for equipment, exterior junction boxes, exterior pull boxes, exterior wireways and gutters, and rooftop equipment (i.e.: supply and exhaust fans, rooftop HVAC equipment) with stainless steel screws.
   a. Utility Power: White letters on black background.
      Generator Power (White letters on red background.
      UPS Power: White letters on blue background.
      Load Bank Circuits: White letters on green background.
      Solar or Wind Power Generation: White on orange background.
   b. Identifying nameplates shall have 1/2-inch high, engraved letters for equipment designation and ¼-inch letters indicating source circuit designation, (i.e.: “PANEL HA –fed from MDP-6 located in Mech. Rm. 100”). The words “fed from” and “located” shall be included in the labeling.
      Example: Panel HA
      Fed From MSB
      Located Main Elec. RM 100
      Example: Disconnect for Panel LK
      Location: Kitchen
      Fed From Transformer TLK
      Located Main Elec. RM 100
   c. Each switchboard, distribution panel, transfer switch, generator transfer device (GTD) for emergency lighting, and motor control center feeder or branch circuit device shall have a nameplate showing the load and location of load served in ¼-inch high, engraved letters. Circuit breaker name and kirk key designation if applicable.
   d. Each section of multiple section panelboards shall also indicate panelboard section number (i.e.: Panel “HA-Section 2 – fed from MDP-6 located in Mech. Rm. 100”).
   e. Motor Controllers, starters, and contactors: Provide neatly typed label inside each motor controller and contactor enclosure door identifying motor or load served, nameplate horsepower, full load amperes, code letter, service factor, and voltage / phase rating.
   f. Individual motor controller and contactor nameplates shall include load served, location of load served, panel and circuit numbers serving load, location of panel serving load, panel and circuit number serving control

circuit, location of panel serving control circuit (if different from panel serving load), description and location (if applicable) of control controlling contactor (i.e. Controlled: Switch in RM 100, and Controlled: BMCS). Contactor nameplate is to include whether it is a lighting or receptacle contactor and name of contactor. i.e., C-1.

Lighting Contactor Example	Receptacle Contactor Example
Lighting Contactor C1 West Parking Lot Pole Lights Fed From Panel HA-2,4,6 Located Main Elec. Rm. 100 Control Circuit-Panel LA 42 Located Main Elec. Rm. 100 Controlled-BMCS	Receptacle Contactor C2 Table Recpts Lab Rm 100 Fed From Panel LA-2,4,6,8 Located Mech. Rm. 110 Control Circuit-Panel LA-42 Controlled-Emer Shut Off Mushroom Switch Rm 101
GTD Example	
Exterior lighting wall packs / north soffit / west metal canopy Fed from Panels EHA-2 located in Elec. RM 105 and HA-1 via Lighting Contactor controlled by BMCS located in Elec. RM 200.	

g. Exterior J-boxes, pull boxes, and gutters shall have panel identification, circuit numbers, and location of panel listed on name plate. Low voltage shall be identified per contents, examples: DATA, BMCS, F/A

h. Name plates on equipment served from switchboards, distribution panels, I-Line panels, and motor control centers are not to include circuit numbers shown on drawings as the circuit numbers are for construction drawing purposes only.

i. Panel names for 277/480v shall start with the letter “H” and 120/208v, 120/240v shall start with the letter “L”. No panel shall be named to include a number other than multi sectional panels, example HA-section 2. New panels installed in renovation or site additions shall have names approved or designated by Owner’s electrical representative. Panel names shall not include the letter “I”. Transformer names shall start with the letter “T” followed by the panel name it serves, i.e., TLA.

j. Main service ATS label shall include equipment name, emergency source and location, normal power source and location, panel served and location. Wall mounted ATS serving lighting loads shall include type of lighting and location, emergency panel and circuit ID and location of panel, normal panel and circuit ID and location of panel.

Main Service ATS Example ATS-1	Wall Mounted Lighting ATS Example ATS
Emer Power-Emer Generator Located Chiller Yard Normal Power-MSB Located-Mech Rm 100 Serves Panel EHA Located-Mech Rm 100	Exterior Wall Packs/Soffit Lights North/West Metal Canopy Lights Fed from EHA-2 Located Mech Rm 200 Fed From HB-4 Located Mech Rm 150

k. Name plates shall include rated bus amperage, voltage, number of phases, number of wires and type of essential electrical system as applicable.

l. Switchgear, switchboards, panelboards, motor control centers, or service equipment available fault current labeling: Provide a 2x3 inch permanently affixed (notice) label with white lettering on contrasting blue background permanently affixed to the equipment prior to energizing the equipment. The label shall include the date of installation and the date of

calculation and comply with ANSI Z535.4 current standards design and durability. The date of calculation shall be the date indicated by the Engineer of Record's seal on the Construction Documents. Example:

AVAILABLE FAULT CURRENT: ##, ### AMPS
DATE OF INSTALLATION: MM/DD/YY
DATE OF CALCULATION: MM/DD/YY

3. Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include explicit description and identification of items controlled by each individual breaker, including final graphics room number or name designation and name of each item served. If no building appointed room number or name is given, list locations per the following examples – A. Storage in Rm 100 – B. Office in Rm 100 – C. Storage west of Rm. 100. List corridors as "corridors". Identify circuits controlled by contactors using a separate notation for each contactor used. List notation at bottom of schedule stating the circuits are controlled by a contactor, list exact location of contactor, and how switched. Do not use architectural room number designation shown on plans. Obtain final graphics room number identification from Architect's final room number graphics plan. All locations served by breakers shall be listed on schedule. Panel schedule shall be large enough to contain all information required. Also refer to Section 26 24 16.
4. Permanent, waterproof, black markers shall be used to identify each lighting and power grid junction box, gutter and wireway. Clearly indicate the panel and branch circuit numbers available at that junction box, gutter or wireway. Where low voltage relay panels are used for lighting control, identify the low voltage relay panel and number in addition to the branch circuit panel and number.
5. Pull Boxes, Transformers, Disconnect Switches, etc.: Field work each with a name plate showing identity, voltage and phase and identifying equipment connected to it. The transformer rating shall be shown on the panels or enclosures. For an enclosure containing a motor starter, the nameplate shall include the Owner's motor number, motor voltage, number of motor phases, motor load being serviced, motor horsepower, and motor full load current. Nameplates shall also indicate where panel is fed from.

B. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.

C. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient size to convey adequate information at each location, mount permanently in an appropriate and effective location. Comply with industry standards for color and design.

D. Wire and Cable Markers: Provide vinyl cloth markers with split sleeve or tubing type, except in manholes provide stainless steel with plastic ties.

E. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways, contactors, and motor controllers and load connection. Identify with panelboard / switchboard branch circuit or feeder number for power and lighting

circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

F. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red for 50 volts or above electrical, or orange for communications and control with suitable warning legend describing buried electrical lines; telephone lines and data lines per APWA recommendations. All underground electrical conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground electrical conduits.

G. Lighting Controls and Equipment: Provide self-adhesive machine typed tape labels with ¼" high white letters on ½" tall black background for digital lighting modules as "DLM". Modules or relays located above ceiling: adhere label to bottom of ceiling T-grid below relay location. Modules or relays located in mechanical or electrical rooms or other areas other than above ceiling: Adhere label to the cover of the module or relay and identify the area they control as "MAIN GYM", "BAND HALL", or "CORRIDOR 100", etc. Remote lighting control switches or push-button stations located remotely from the area they control: Adhere label to device face plate, not obstructing screw fasteners, and intuitively identify function such as "GYM LTG LOW-HIGH" or "CAFE LTG DIM", etc.

3.2 CUTTING AND PATCHING

A. General: Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.3 INSTRUCTION OF OWNER'S PERSONNEL

A. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the electrical systems.
   1. Provide the training during regular working day.
   2. The instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.
   3. Refer to other specification sections for additional training and commissioning requirements.

B. Time to be allocated for instructions.
   1. Minimum of 20 hours dedicated instructor time.
   2. 4 hours on each of 5 days.
   3. Additional instruction time for specific systems as specified in other Sections.

C. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
   1. One copy to the Owner.
   2. One copy to the Architect / Engineer.

D. The Owner shall provide a list of personnel to receive instructions and shall coordinate their attendance at the agreed upon times.

E. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shut down of each item of equipment.

G. Demonstrate equipment functions (both individually and as part of the total integrated system).

H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

I. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.

J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he / she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.4 OPENINGS

A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.5 HOUSEKEEPING PADS

A. Provide concrete equipment housekeeping pads under all floor and outdoor mounted electrical equipment.

B. Concrete and reinforcing steel shall be as specified in Division 3, or as indicated or noted.

C. Concrete pads:
1. 6-inches thick minimum indoors; 8-inches thick minimum outdoors or match existing if indicated on the drawings to extend existing pads, or in other sections of the specifications.
2. Chamfer strips at edges and corner of forms.
3. Smooth steel trowel finish.
4. Extend 3-inches minimum indoors beyond perimeter of equipment unless otherwise shown.
5. 6-inch x 6-inch #8 wire reinforcement mesh.

3.6 OBSTRUCTIONS

A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 VANDAL RESISTANT DEVICES

A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used, and 25 percent spare fasteners.

B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.8 PROTECTION

A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

B. Do not deliver equipment to this project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.9 COORDINATION OF BRANCH CIRCUIT OVERCURRENT AND PROTECTION DEVICES

A. Review with equipment specified which requires electrical connections. Review equipment shop drawings and manufacturer's nameplate data and coordinate exact branch circuit overcurrent protective device and conductors with equipment provided.
   1. Provide equipment manufacturer's recommended overcurrent protective device indicated on nameplate at no additional cost to the Owner.
   2. If branch circuit conductors and / or conduit sizing is less than the minimum required by equipment manufacturer, notify the Architect / Engineer immediately, prior to rough-in.
   3. If equipment manufacturer is a substitution to the specified equipment manufacturer, provide the greater of the conductors specified or those required for the installed equipment manufacturer’s minimum circuit conductors, at no additional cost to the Owner.
   4. If conductors indicated on plans are in excess of that permitted by equipment manufacturer, notify Architect / Engineer immediately, prior to rough-in.
   5. If conductors indicated on plans are in excess of that permitted by the equipment manufacturer, provide the maximum conductors permitted by the equipment manufacturer based on NEC ampacity tables, either in a single set, or as a set of parallel conductors as permitted by the NEC. Conductor size and quantity entering the equipment enclosures shall not exceed the equipment manufacturer’s maximum recommendations.

3.10 FAULT CURRENT AND ARC FLASH STUDY FOR OVERCURRENT DEVICE COORDINATION

A. Contractor shall provide a coordination study, fault current analysis, and Arc-Flash study report for new electrical distribution equipment downstream to the last new overcurrent device in each feeder or branch circuit, conducted and prepared by the switchgear manufacturer. The coordination study and fault current analysis shall include the manufacturer’s recommendations for all adjustable overcurrent devices specified or provided. Study does not require inclusion of existing switchgear, except it shall include existing or new overcurrent devices in existing switchgear serving new switchgear. Contractor shall submit the report results prior to submitting switchgear submittals to allow changes or modifications to equipment selection.

B. Contractor shall adjust all overcurrent device settings based on manufacturer's recommendations, or as directed by Owner / Architect at no additional cost to Owner. Settings for GFI shall be set at maximum as permitted by the NEC.

C. Arc-Flash & Shock-Hazard Warning Labels: Provide arc-flash and shock hazard-warning labels that comply with ANSI Z535.4 on switchgear, switchboards, transformers, motor control centers, panelboards, motor controllers, safety switches, industrial control panels and other equipment that is likely to require examination, adjustment, servicing, or maintenance while energized. Locate the marking to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment. On renovation projects, install arc-flash warning labels on existing equipment where lock-out / tag-out will be required for the renovation work. Provide the information listed below on each label. Specify that arc-flash warning label information be produced by the electrical equipment manufacturer or supplier as a part of the final power system studies to be submitted by the Contractor in accordance with the electrical acceptance testing.
   1. Note: In addition to the final arc-flash analysis, the final power system studies include load flow and fault-current calculations, and an overcurrent protective device (OCPD) coordination study based on the actual equipment to be installed for the project.

D. Information to be determined and applied to electrical equipment:
   1. Arc-Flash Protection Boundary.
   2. Arc-Flash incident energy calculated in accordance with IEEE Std 15841 ™.
   3. Working distance calculated in accordance with IEEE Std 1584a ™.
   4. NFPA 70E Hazard / Risk Category Number or the appropriate personal protective equipment (PPE) for operations with doors closed and covers on.
      a. Typical operations include operating circuit breakers, fused switches, and meter selector switches.
   5. System phase-to-phase voltage.
   6. Condition(s) when a shock hazard exists (e.g., "With cover off").
   7. Limited Approach Boundary as determined from NFPA 70E, Table 130.2(C).
   8. Restricted Approach Boundary as determined from NFPA 70E, Table 130.2(C).
   9. Prohibited Approach Boundary as determined from NFPA 70E, Table 130.2(C).
   10. Unique equipment designation or code (described under "Component Identification".
   11. Class for insulating gloves based on system voltage (e.g., Class 00 up to 500V)
   12. Voltage rating for insulated or insulating tools based on system voltage (e.g., 1000V).
   13. Date that the hazard analysis was performed.
   14. "Served from" circuit directory information including the serving equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
   15. If applicable, the "serves" circuit directory information including the served equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
   16. An abbreviated warning label may be used where it has been determined that no dangerous arc-flash hazard exists in accordance with IEEE 1584a ™, paragraph 9.2.3.
   17. Use a "DANGER" label where the calculated arc-flash incident energy exceeds 40 cal/cm.

E. Submittals: Submit four copies of coordination study and certified fault current study results to the Architect for review.

3.11 EQUIPMENT BACKBOARDS

A. Backboards: ¾ inch, fire retardant, exterior grade plywood, painted gray, both sides.
   1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each new telephone equipment terminal location.
   2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each new data / voice / video / communications equipment location / cable TV head end equipment, or security equipment location.

3.12 TESTING

A. The contractors for the various sub-systems shall submit proposed testing procedures for their systems, subject to review and approval and Owner acceptance. The contract will not be declared to be substantially complete until the functional operation of the subsystems have been demonstrated and verified and reports have been provided, reviewed and accepted.

B. The project will not be declared substantially complete until the following has taken place.
   1. The “As-Built” drawings have been submitted, reviewed and accepted by the Architect / Owner / Owner’s Construction Representative.
   2. The building emergency lighting system and other systems including but not limited to those listed below have been tested, completed factory start-up and programming and adjusting as required for a complete and fully operational system acceptable to the Architect and Owner.
      a. Occupancy Sensor and Lighting Controls.
      b. Surge protective device equipment.
      c. Overcurrent devices.
      d. Motor Controllers.
      e. Emergency Lighting.
      f. Building Fire Alarm System.
      g. Clock System.
      h. Television Distribution System.
      i. Building Data / Voice Cabling System.
      j. Surveillance and Security System.
      k. Intercom / Telephone.
      l. Sound Reinforcement Systems.
      m. Building Lightning protection System.

3.13 LOAD BALANCING

A. Balance the loads on each low-voltage feeder so that the voltage on each phase is within +/- 1.0% of the average voltage of the three phases. Refer to the DOE Office of Industrial Technologies, “Motor Tip Sheet #7” dated September 2005 available for download to PDF format at no charge at: http://www1.eere.energy.gov/industry/bestpractices/pdfs/eliminate_voltage_un_balanced_motor-systemts7.pdf.

END OF SECTION

SECTION 26 05 09

ELECTRIC UTILITY COORDINATION AND SERVICE ENTRANCE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. General: Electrical service shall be provided by local utility company.

B. Power Company Data: Obtain from utility company information and installation standards for electrical service installation.

C. Responsibilities: Determine what equipment and labor is provided by utility company and what equipment and labor is required of this Contractor.

PART 2 - PRODUCTS

2.1 GENERAL

A. Service Data: Ensure that utility company service data is accurate and verified.

2.2 PRIMARY SERVICE

A. General: Division 26 shall provide primary service conduit, concrete transformer pads, concrete duct bank, utility service and metering equipment enclosures, manholes, and pull boxes as required and as specified.

B. Utility company shall provide primary cables, splices, utility metering instruments, terminations, and primary underground and overhead service conductors.

2.3 TRANSFORMERS AND SWITCHGEAR

A. General: Division 26 shall make provisions for service as required by utility company, including, but not limited to permanent or removable/lockable vehicular barriers, grounding rods, grounding conductors, and sleeves.

B. The utility company shall provide service transformers, primary switchgear, primary protective relaying, and connections to the customer service.

2.4 SECONDARY SERVICE CONDUCTORS

A. General: Division 26 shall provide secondary service entrance conductors, conduit and concrete duct bank.

with anchor bolts. Hot dipped tubular steel cross members as required for equipment support. Support structure shall support approximately 1,200 pounds of equipment and minimum 150 MPH wind loading.

2.5 SECONDARY SERVICE CABLE TAP BOXES

A. General: Division 26 shall provide secondary service cable tap boxes only if required or specified and as approved by the utility company. Where required or specified, enclosure shall be constructed of aluminum or stainless steel NEMA 3RX construction.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Standards: The installation of the service entrance provisions shall comply with the published standards and requirements of the utility company, the utility company's specific construction requirements for this project, and with requirements of this Division.

B. Correction: Any failure to meet the standards and requirements shall be corrected to the satisfaction of the utility company and Owner without any additional cost to the Owner.

C. Contractor shall provide all construction materials and labor that the utility company determines to be the responsibility of the customer, at no additional cost to the Owner.

D. The materials and labor required by the for a complete installation shall be provided by the contractor and includes, but is not limited to permanent or removable / lockable vehicular barriers, grounding rods, grounding conductors, sleeves, concrete pads, concrete reinforced ductbanks, conduits, metering racks and metering enclosures.

E. Utility distribution poles and service entrance ductbank locations shall be staked and surveyed prior to pole installation by the Contractor to verify their proper placement is within the Owner's property and respective utility easements. Contractor shall verify by survey that the pole and service entrance ductbank location and easements do not interfere with existing easements, right-of-ways, or other restricted properties. Conflicts with existing easements and restrictions shall be brought to the attention of the Architect prior to construction.

F. Contractor shall initiate contact with the power provider (retail seller), utility (transmission and distribution), and Owner within 14 days of Notice to Proceed to ensure permanent power will be available to the site. Any delays resulting from lack of this coordination shall be the responsibility of the Contractor.

END OF SECTION

SECTION 26 05 12

ELECTRICAL SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Prepare submittals as required by Division 01 and as outlined below.

B. Provide individual submittals based on the project specification section number and description and only items specified or required in that specific project specification section.

C. Submit product data shop drawings only for the following items indicated below when included as part of the project specifications, and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review, typically for basic materials and commodity off-the-shelf materials, and/or to imply that materials shall be provided as specified without exception.

D. The term submittal, as used herein, refers to all:
1. Shop Drawings.
2. Coordination Drawings.
3. Product data.

E. Submittals shall be prepared and produced for:
1. Distribution as specified
2. Inclusion in the Operating and Maintenance Manual, in the related O&M manual section.

1.2 ARCHITECT / ENGINEER REVIEW OF SUBMITTALS

A. The Architect / Engineer will:
1. Review requested submittals with reasonable promptness. Specific equipment submittal within a materials specification section that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
2. Affix stamp and initials or signature and indicate requirements for resubmittal or exceptions to submittal as submitted.
3. Return submittals to Contractor for distribution or for resubmission.

B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.

C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes, or coordination with the work of other trades.

D. The review of a separate item as such will not indicate approval of the assembly in which the item functions.

1.3 SUBSTITUTIONS

A. Do not make requests for product or material substitution employing the procedures of this Section. The procedure for making a formal request for substitution is specified in Division 01.

PART 2 - PRODUCTS

A. Each individual submittal shall be an individual specific electronic data file with the file name resembling the product specification section number and title. Refer to Division 01 for additional data file format and media requirements.

PART 3 - EXECUTION

3.1 SPECIFICATION COMPLIANCE REVIEW

A. Do not submit an outline form of compliance, submit a complete copy with the product data.

B. Mark up a complete copy of the complete specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:).

C. Variances for roduct ot materials typically include updated model numbers or updated versions of the specified product from the same manufacture or an equal or better product from the approved manufactures list. Substutions from manufacture’s not on the approved manufacture’s will not be reviewed unless prior approval using one of the procedures for substitutions or changes in the contract documents are followed as requried in Division 01.

3.2 COMPOSITE COORDINATION DRAWINGS

A. Produce a set of composite coordination drawings for above ceiling, below ceiling, and below floor of electrical, mechanical, and technology equipment rooms and equipment yards for review and comment within four (4) weeks of receipt of Owner’s official Notice to Proceed. Show coordination of items including but not limited to structural and architectural elements, all mechanical and plumbing piping, ductwork, equipment, electrical conduit, low voltage communications and safety/security systems cabling, cable trays, lighting, electrical switchgear, generators and UPSs, and any public or private building utility services.
   1. Prepare the composite plans at one-quarter inch (1/4”) equals one-foot scale. Include larger scale sections with vertical elevations of elements as required to confirm coordinate of all elements.
   2. For each room containing major electrical switchgear and each outside equipment area with major electrical switchgear and other equipment also include NEC working space, NEC equipment space, and NEC access to NEC working space, and housekeeping pad location and dimensions.
   3. Prepare coordination drawings to coordinate installations for efficient use of available space allowing for future additional equipment wherever possible, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
   4. Identify field dimensions. Show relation to adjacent or critical features of work or products.

B. Submit composite coordination shop drawings in plan, elevation and sections, showing receptacles, outlets, electrical and telecommunication devices in casework, cabinetwork and built-in furniture.
   1. Verify location of wiring devices and outlets, communication devices and outlets, safety and security devices, and other work specified in this Division.
   2. Coordinate with drawing details, site conditions, composite coordination drawings, and millwork other equipment shop drawings prior to installation.
   3. Submit coordination and shop drawings prior to rough-in and fabrication.

3.3 EQUIPMENT SHOP DRAWINGS AND PRODUCT DATA

A. Submittals shall not be combined or bound together with any other material submittal. Do not submit entire product catalogs, submit only specific data sheets indicating required product information and available product options or accessories.

B. Submittal Specification Information:
   1. Every submittal document shall bear the following information as used in the project manual:
      a. The related specification section number.
      b. The exact specification section title.
      c. Additional identifiers as required in Division 01.
   2. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been submitted or delivered.

C. All product options specified shall be clearly indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as either part of or not part of the product data submitted shall become part of the Contract and shall be assumed to be provided with the product submitted.

D. Mark each copy of standard manufacture’s printed data to identify pertinent products, referenced to specification section and article number.

E. Show reference standards, performance characteristics and capacities; wiring diagrams and controls; component parts; finishes; dimensions and required clearances.

F. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete or strike through information not applicable.

G. Submit drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.

H. Show all dimensions of each item of equipment in its to be installed assembled condition with all components assembled. Include a series of drawings of individual components as necessary for reference.

I. Identify field dimensions; show relation to adjacent or critical features or work or products.

J. Submit individually bound shop drawings and product data for the following when specified or provided.

K. The Fault Current and Overcurrent Device Coordination Analysis shall be submitted prior to other electrical switchgear dependent on the results of the study for specific product selection by the vendor or contractor for compliance with the study.
   1. The emergency life safety power system equipment shall be fully coordinated as

required by the NEC.

2. The AIC and WCR ratings of all products meet or exceed the available fault current at that equipment's location.
3. Electrical systems other than life safety power systems shall be coordinated as much as practicable while reducing arc flash energy as much as practical.

L. Required submittals when products are indicated or specified:

1. Fault Current and Overcurrent Device Coordination Analysis. Submit this analysis at a minimum of three (3) weeks prior to any overcurrent device submittal to allow review for modifications to overcurrent device product selection submittal based on the manufacture's analysis and recommendations. Manufacture's recommendations for code compliance equipment fault tolerance are a project requirement and shall be provided at no additional cost to the Owner. Manufacture's recommendations for arc flash reduction that result in no additional cost to the Owner shall be provided. Manufacture's recommendations for arch flash reduction which would result in additional cost to the Owner are considered recommendations only and will be reviewed by the Engineer during the submittal review and may or may not result in changes to the specified or submitted equipment.
2. Enclosed Switches, non-fused, fused, or circuit breaker.
3. Panelboards.
4. Load centers.
5. Wiring devices.
6. Lighting fixtures.
7. Lighting Controls.
8. Surge Protection Devices.
9. Transformers.
10. Electrical Contactors.
11. Enclosed Motor Controllers.
12. Site Lighting Photometrics, Poles, and Fixtures.
13. Switchboards, including renewal components for existing switchboards.
14. Elevator Power Module fused switches.
15. Fuses.
16. Recessed floor boxes and fittings.
17. Metering equipment for building management energy monitoring, usage, IECC compliance.
18. Modular metering equipment for multi-tenant utility electrical services.
19. Emergency/Standby generators.
20. Automatic transfer switches.
21. Manual transfer switches with or without integral generator docking stations.
22. Remote generator docking stations.
23. Emergency lighting inverters.
24. Theatrical Lighting Systems.
25. Architectural Dimming Systems.
26. Electrical cable trays.
22. Sports Lighting Equipment, Photometrics, Fixtures, and Poles.
27. Surface Raceways.
28. Electrical controls and time switches.
29. Motor control centers, including renewal components for existing motor control centers.
30. Busway.
31. Uninterrupted Power Supply systems.
32. Power quality improvement filters or capacitors.
33. Lightning protection system.
34. Fire Rated Cables and Connectors.
35. Low Voltage Switchgear.

36. Medium Voltage Cable and Connectors.
37. Medium Voltage Switchgear.

3.4 MANUFACTURERS INSTRUCTIONS

A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

3.5 CONTRACTOR RESPONSIBILITIES

A. Review, make corrections or annotations for clarification of manufacturer supplied data, stamp and sign submittals prior to transmittal.

B. Determine and verify:
1. Field measurements.
2. Field construction criteria.
3. Manufacturer's catalog numbers.
4. Conformance with the Contract Documents.

C. Coordinate submittals with requirements of the work and of the Contract Documents.

D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.

E. Do not fabricate products, or begin work for which submittals are required, until such submittals have been produced and bear contractor's stamp of acceptance or approval. Do not fabricate products or begin work until return of reviewed submittals with Architect / Engineer's acceptance.

F. Contractor's responsibility for errors, omissions, or un-approved substitutions in submittals is not relieved whether Architect / Engineer reviews submittals or not.

G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations identified by the Contractor on reviewed documents.

H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
1. Proper sizes and capacities.
2. That the item will fit in the available space in a manner that will allow proper service; manufacture’s and code required clearances.
3. Construction methods, materials and finishes.

I. Schedule submissions at least 15 days before date reviewed submittals will be needed by the Contractor for processing or for making corrections for re-submittal.

J. General and Electrical Contractor’s Stamp of Approval
1. The general contractor and the electrical contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
2. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that

Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.

3. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
4. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

3.6 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor. Product and equipment related to site work or other trades which require extensive rough-in, foundations, or structural support shall be submitted as soon as possible after given notice to proceed with construction.

B. Number of submittals required:
1. Coordination Drawings: Submit one electronic data file (pdf) and three opaque reproductions or coordination drawings.
2. Product Data: Submit electronic data PDF files. Refer to Division 01 for specific requirements. PDF files that are 20MB or larger may indicate that a submittal includes information not specifically relevant to the specific product being provided, information not required for the review of the specific product such as a complete product catalog or catalog section. Contractor shall include only the product data required to review the specific products characteristics for compliance with the contract documents.

C. Accompany submittals with transmittal letter containing:
1. Date.
2. Project title and number.
3. Contractor's name, address and contact information.
4. The number of each Shop Drawing, Project Datum and Sample submitted.
5. Other pertinent data as required in Division 01.

D. Submittals shall include:
1. The date of submission.
2. The project title and number.
3. Contract Identification.
4. The names of:
   a. Contractor.
   b. Subcontractor.
   c. Supplier.
   d. Manufacturer.
5. Identification of the product.
6. Field dimensions, clearly identified as such.
7. Relation to adjacent or critical features of the work or materials.
8. Applicable standards.
9. Identification of deviations from contract documents.
10. Suitable blank space for General Contractor and Architect / Engineer stamps.
11. Contractor's signed and dated Stamp of Approval.

E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
1. Finishes which involve Architect / Engineer selection of colors, textures or patterns.
2. Associated items requiring correlation for efficient function or for installation.

3.7 RESUBMISSION REQUIREMENTS

A. Make resubmittals under procedures specified for initial submittals. Re-submittals shall be a complete submittal as if it were the initial submittal unless otherwise instructed in the review comments on the original submittal.
   1. Indicate that the document or sample is a resubmittal
   2. Identify changes made since previous submittals

B. Indicate any additional changes which have been made by the contractor other than those requested by the Architect / Engineer.

END OF SECTION

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SECTION 26 05 16

EXCAVATING, BACKFILLING AND COMPACTING FOR ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 apply to this section.

B. Refer to Instructions for substitution of materials and products.

C. Addenda issued during the bidding period that affect this section of the specifications.

1.2 WORK INCLUDED

A. Coordinating all excavating and backfilling for the electrical underground, and all related appurtenances. Provide concrete duct banks as specified in other related Division 26 specification sections.

B. The extent of raceways, excavation, and backfill shall be in conformance with the locations, raceways, elevations and grades shown on the drawings.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM) Use current edition.
1. ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
2. ASTM D1556, Standard Test method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
4. ASTM D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

B. Local Authority Having Jurisdiction Standards.

C. Local Governing Agencies or Utilities.

1.4 WARRANTY

A. Provide written warranty against defects in the material and workmanship for the work of this Section for a period of one year from the Date of Substantial Completion of the Project. Refer to Division 1 for Warranty form.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Concrete: Refer to other Division 26 specification section where concrete encasement is required or specified.

B. Cement-Stabilized Sand: Clean, local sand mixed with not less than 1-1/2 sacks of Portland cement per ton; mix in a mill-type mixer.

C. Sand: Clean, local sand

D. Earth Backfill: Clean local material consistent with the surrounding earth material and free of large clods, roots, organic materials, rocks or other debris.

PART 3 – EXECUTION

3.1 EXCAVATION

A. General:
1. All utility trenches shall be constructed in conformance with OSHA trench safety standards.
2. Refer to project Geotechnical Report for additional requirements for excavating and backfilling of utility trenches.
3. Sheeting and shoring shall be accomplished to the extent necessary to maintain the sides of the trench in a vertical position throughout the construction period for trenches five feet in depth or deeper. Where approved, trench sides may be laid back in lieu of shoring to meet OSHA safety standards.
4. Utilities shall not be constructed or laid in a trench in the presence of water. All water shall be sufficiently removed from the trench prior to the raceway placing operation to ensure a dry, firm bed on which to place the raceway.

B. Appurtenances:
1. Any overdepth excavation below appurtenances shall be refilled with cement-stabilized sand.

C. Electrical Trenches:
1. Electrical underground raceways must be the minimum depth required by the local governing authority and Power Company.
2. Trench width for the electrical raceway shall be a minimum of the outside raceway encasement plus 12 inches.
3. Trenches shall be excavated to a depth of at least 6 inches below the conduit raceway. The conduit raceway bedding or concrete encasement shall then be placed in accordance with the specifications, local governing authority, and Power Company standard details.

3.2 BEDDING AND BACKFILL

A. Electrical Trenches:
1. Place backfill, consisting of sand or cement stabilized sand, to a depth of one foot above top of raceway or concrete duct bank and compact to 90% maximum density.
2. Backfill the remainder of the trench in 6 inch lifts with select excavated material and compact as required to achieve density of soil of surrounding area.

B. Utility Locators:
1. Provide metallic locators for utility company raceways as required by respective utility.
2. Refer to other specification sections for additional requirements for underground raceway locators and markers.

END OF SECTION

SECTION 26 05 19

CONDUCTORS AND CONNECTORS – 600 VOLT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide electrical conductors, wire and connector work as shown, and specified.

B. Types: The types of conductors and connectors required for the project include the following:
   1. 600V building conductors.
   2. 600V building conductor connectors.

C. Application: The applications for conductors and connectors required on the project are as follows:
   1. Power distribution circuitry.
   2. Lighting branch circuitry.
   3. Appliance, receptacle, and equipment branch circuitry.
   4. Motor branch circuitry.
   5. Control wiring.
   6. Line voltage.

D. Refer to other specific specification sections for voice, video, data, alarm and instrumentation cables.

1.2 QUALITY ASSURANCE

A. UL Label: Conductors and connectors shall be UL labeled.

1.3 REFERENCES

A. Refer to other specific specification sections regarding specialized wiring and connections.

PART 2 – PRODUCTS – Provide products manufactured in the USA

2.1 CONDUCTORS AND CONNECTORS

A. General: Except as indicated, provide conductors and connectors of manufacturer's standard materials, as indicated by published product information, designed and constructed as instructed by the manufacturer, and as required for the installation.

B. Cable Lubricant: Fire resistant, nonflammable, water-based type for standard building conductors. Provide cable lubricants for fire rated cables as recommended by the cable manufacturer.

C. Conductors: Provide factory-fabricated conductors of the size, rating, material, and type as indicated for each use. Conductors shall be soft or annealed copper wires meeting, before stranding, the requirements of ASTM B 3, Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes, latest edition.
   1. Conductors for control wiring sized #14 AWG through #10 AWG shall be stranded.
   2. Conductors for power and lighting shall be stranded. Stranding shall be Class B meeting the requirements of ASTM B 8, Standard Specification for Concentric-

Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft.

D. Insulation for standard building conductors: Insulation shall meet or exceed the requirements of UL 83, Standard for Thermoplastic Insulated Wires.
   1. All wiring inside lighting fixtures shall be temperature rated per NEC.
   2. Insulation for copper conductors shall be UL Type THHN/THWN, 90 degrees C.

2.2 COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

A. Color coding for conductors as required by NEC 210.5. Color coding for phase and voltage shall be as required by local codes and local standards. Where such standards do not exist, color coding shall be as follows:

Color Code Table	**USE CONTINUOUS COLOR CODED INSULATION THROUGHOUT**					
System/ Phase	**A**	**B**	**C**	**N**	**G**	**IG**
120/208 3 Ph	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240 3 Ph	Black	Orange	Blue	White	Green	Green/Yellow Stripe
120/240 1 Ph	Black	N/A	Blue			
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Notes to Color Code Table:
1. 120/208, 120/240, and 277/480 Volt Systems shall be routed in separate raceways.
2. Switched legs of phase conductors for lighting and appliance branch circuits shall be of the same color as described above throughout the entire circuit.
3. Conductors shall be the same color from breaker to device or outlet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install electrical conductors and connectors as shown, in accordance with the manufacturer's written instructions, the requirements of NEC, the NECA Standard of Installation, and industry practices.

B. Coordination: Coordinate conductor installation work with electrical raceway and equipment installation work, as necessary for interface.

C. Conductors:
   1. Provide a grounded (neutral) conductor for each branch circuit. Do not share grounded (neutral) conductors.
   2. No more than six phase conductors shall be installed in a single raceway. Any combination of phase conductors and grounded (neutral) conductors in any raceway shall not exceed nine.
   3. When any combination of four or more phase and grounded (neutral) conductors are installed in a raceway, the minimum size for all conductors including equipment ground conductor shall be #10 AWG, and they shall be de-rated accordingly.
   4. When more than four (4) conductors are size #10 AWG, they shall be installed in

a one-inch conduit.

5. Pull conductors together when more than one is being installed in a raceway. Whenever possible, pull conductors into their respective conduits by hand. Use pulling lubricant when necessary.
6. Before any conductor is pulled into any conduit, thoroughly swab the conduit to remove foreign material and to permit the wire to be pulled into a clean, dry conduit.
7. Run feeders their entire length in continuous section without joints or splices.
8. No wire smaller than #12 AWG shall be permitted for any lighting or power circuit. No wire smaller than #14 AWG shall be used for any control circuit, unless shown otherwise.
9. Provide the same size wire form the panelboard to last outlet on circuit. For 20 amp branch circuits operating at 150V or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating at 150 to 600 volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
10. Branch circuit voltage drop shall not exceed 3% of rated voltage.
    a. Total voltage drop from the point of service to the last outlet or utilization equipment of the same voltage shall not exceed five-percent of rated voltage.
    b. Total voltage drop from the point of service to transformers with adjustable taps, buck-boost transformers, uninterruptable power supplies (UPS), or voltage regulators shall not exceed five-percent of rated voltage.
    c. Total voltage drop from a separately derived system, transformer with adjustable taps, buck-boost transformer, uninterruptable power supply (UPS), or voltage regulator to the last outlet or utilization equipment of the same voltage shall not exceed five-percent of rated voltage.
    d. Total voltage drop from the point of service to distribution equipment of the same voltage shall not exceed two-percent of rated voltage.
    e. Branch circuit voltage drop from distribution equipment to the last outlet or utilization equipment shall not exceed three-percent of rated voltage.
    f. Provide the same size branch circuit conductors to last outlet on circuit unless specifically noted or indicated otherwise on the drawings. For 20 amp branch circuits operating at 150-Volts or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating above 150-Volts to 600-Volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
11. No tap or splice shall be made in any conductor except in outlet boxes, pull boxes, junction boxes, splice boxes, or other accessible locations. Make taps and splices using an approved compression connector. Insulate taps and splices equal to the adjoining conductor. Make splices or taps only on conductors that are a component part of a single circuit, protected by approved methods. Taps or splices in feed through branch circuits for connection to light switches or receptacles shall be made by pigtail connection to the device.
12. Support conductors in vertical raceways, as required by the NEC.
13. Do not permit conductors entering or leaving a junction or pull box to deflect to create pressure on the conductor insulation.
14. Make joints in branch circuits only where circuits divide. These shall consist of one through circuit to which the branch from the circuit shall be spliced.
15. Make connections in conductors up to a maximum of one #6 AWG wire with two #8 AWG wires using twist-on pressure connectors of required size.
16. Make connections in conductors or combinations of conductors larger than specified using cable fittings of type and size required for specific duty.
17. After a splice is made, insulate entire assembly with UL-approved insulating tape to a value equivalent to the adjacent insulation.

18. Make splices and connections in control circuit conductors using UL-approved solderless crimp connectors.
19. All conduits shall be installed with an insulated grounding conductor per NEC 250.122. Where green conductor insulation is not available, the ground conductor shall be identified with green phasing tape at all accessible locations.
20. Neatly train and lace wiring inside boxes, equipment and panelboards. Provide tie-straps around conductors with their shared neutral conductor where there are more than two neutral conductors in a conduit.
21. Clean conductor surfaces before installing lugs and connectors.
22. Make splices, taps and terminations to carry full ampacity of conductors with no perceptible temperature rise.
23. Provide stranded conductors connected with pressure type connectors / compression fittings and terminal lugs UL listed for the type of conductor used (AL-CU) and correctly sized to the diameter of the bare conductors.
24. Run mains and feeders their entire length in continuous pieces without splices or joints.
25. Color code conductors.
26. Do not install a pull string in conduits containing conductors.
27. Conductors shall be the same color from load side of overcurrent protection device to outlet or utilization equipment.
28. Spare conductors shall not be installed in any conduit, gutter, raceway, panel or enclosure unless noted otherwise.

D. Identification: Label each phase conductor in each junction box with corresponding circuit number, using self-adhesive wire markers.

E. Splices and Joints:
1. In accordance with UL 486A, C, D, E, and NEC.
2. Aboveground Circuits (No. 10 AWG and smaller):
   a. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220˚ F, with integral insulation, approved for copper and aluminum conductors.
   b. The integral insulator shall have a skirt to completely cover the stripped wires.
   c. The number, size, and combination of conductors, as listed on the manufacturers' packaging, shall be strictly followed.
3. Motor connections:
   a. All AHU motors connections shall be split bolt connectors.
   b. All non-AHU motors 10 HP and larger shall be split bolt connectors.
   c. All non-AHU motors less than 10 HP shall be split bolt connectors or as recommended by the manufacturer.

F. Aboveground Circuits (No. 8 AWG and larger):
1. Connectors shall be indent, hex screw, or bolt clamp type of high conductivity and corrosion resistant material, listed for use with copper and aluminum conductors.
2. Provide field-installed compression connectors for cable sizes 250 kcmil and larger with not less than two clamping elements or compression indents per wire.
3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
4. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

G. Underground Branch Circuits and Feeders:
   1. Submersible connectors in accordance with UL 486D, rated 600 V, 190˚F, with integral insulation.

3.2 TESTING

A. Pre-Energization Check: Before energizing, check cable and conductors for circuit continuity and short circuits. Correct malfunctions.

B. Service Entrance and Feeder Insulation Resistance Test: Each main service entrance conductor and each feeder conductor shall have its insulation resistance tested after the installation is complete except for connection at its source and point of termination. Testing shall be performed by qualified technicians who have been trained in testing procedures and in the use of all test equipment.
   1. Make tests using a Biddle Megger or equivalent test instrument at a voltage of not less than 1000 VDC; measure resistance from conductor to conductor, conductor to neutral (if present) and from conductor to ground. Insulation resistance shall not be less than the following:

Wire Size (AWG)	Insulation Resistance (Ohms)
#8	250 K
#6 through #2	100 K
#1 through #4/0	50 K
Larger than #4/0	25 K

   2. Conductors that do not meet or exceed the insulation resistance values listed above shall be removed, replaced, and retested.

C. Submittals: Contractor shall furnish instruments and personnel required for tests. Submit 4 copies of certified test results to Architect for review. Test reports shall include conductor tested, date and time of test, relative humidity, temperature, and weather conditions.

D. Voltage and Current Values: The voltage and current in each conductor shall be measured and recorded after connections have been made and the conductor is under load.

SAMPLE DC HIGH VOLTAGE CABLE TEST REPORT
(Specification Paragraph 3.2, C)

Date_____

Contract and Work Location: ___
Contract (Project) No.: _
Circuit Identification: ___
(Dwg., Title, Number and Ckt. Number)

Test Equipment: _____
(Make, Model, Serial No., Etc.)
Applied Test Voltage _____
Normal Oper. Voltage _____
Cable Installation: New _____ Used _____
(Date) (No. Years)
Cable Size _____AWG
Cable Length _____Ft.
Cable Material _____Cu _____Al
Temperature _____ Humidity _____

TEST DATA - RESISTANCE IN KILO OHMS

CONDUCTOR PER PHASE	A-N	B-N	C-N	A-G	B-G	C-G	A-B	B-C	A-C

END OF SECTION

SECTION 26 05 26

ELECTRICAL GROUNDING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Grounding shall conform to the requirements of:
   1. National Electrical Code.
   2. Governing local codes.
   3. All Local Utility Companies.

B. Ground effectively and permanently.
   1. Neutral conductor at the main service disconnect and other separately derived systems.
   2. All conduit systems.
   3. All electrical equipment and related current carrying supports or structures.
   4. All metal piping systems.
   5. All building structural metal frames.
   6. All telephone/voice/video/CATV/data utilities.

1.2 REFERENCE STANDARDS

A. ANSI/IEEE Standard 142 - "Recommended Practice for Grounding of Industrial and Commercial Power Systems."

B. ANSI/UL 467 - "Safety Standard for Grounding and Bonding Equipment."

C. Article 250 of the NEC (NFPA 70) for grounding.

D. NECA – Standard of Installation.

E. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

F. EIA / TIA 607.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Copperweld.

B. nVent ERICO.

C. Burndy.

D. O. Z Gedney.

E. Eaton.

2.2 GROUNDING ELECTRODES

A. Driven Rod Electrode
   1. 3/4" x 10'-0" copper clad grounding electrode.

2. UL listed.
3. Approved thermal fusion connector methods (exothermic).

B. Metal frame of building or enclosure.

C. Foundation concrete encased rebar.

2.3 DATA / VOICE COMMUNICATIONS CLOSET GROUND BAR

A. MDF closets/head end rooms: Erico Cadweld #B544A028 ground bar with 7/16-inch holes.

B. IDF closets, Erico Cadweld #B542A004 ground bar with 7/16-inch holes.

C. Heavy-duty, two bolt type, copper alloy or bronze for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

A. Exothermic type for underground and structural steel; Cadweld

B. Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

2.5 WIRE

A. Stranded, copper cable

B. Foundation Electrodes: 4/0 AWG

C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements

PART 3 - EXECUTION

3.1 GROUNDING AND BONDING

A. In the service equipment, provide a separate (dedicated) ground bus.
1. Bond the ground bus with copper bus bar or cable, of equal or greater current carrying capacity of the service grounding conductor, to the neutral bar.
2. Resistance of neutral to ground shall not exceed 10 Ohms.
3. Connect the electric service grounding electrode conductors to the incoming metal water pipe system (when available, using a suitable ground clamp) and to a supplemental electrode such as a ground rod or ground .ring.
4. Provide grounding and bonding at the power company’s metering equipment.
5. Provide access and cover for access to the ground grid and removable connections for testing the system.

B. Connect the grounding electrode conductor between the ground bus and the grounding electrode system.
1. In rigid PVC conduit.
2. Provide thermo fusion connection for each rod ground electrode.
a. All rod electrodes shall be located outside the building in non-paved areas where available. Access cover top shall be flush with finish grade or floor.
b. Install rod electrodes as required. Install additional rod electrodes as required to achieve specified resistance to ground.

c. The minimum distance between driven ground rod electrodes shall be 10'.

3. The total ground resistance shall not exceed 10 Ohms for service entrance grounds and 25 Ohms for equipment grounds.
   a. Where this condition cannot be obtained with one electrode, install a longer electrode, deep-driven sectional electrodes, or additional grounding electrodes until the required ground resistance is obtained.

C. Provide an insulated equipment grounding conductor inside all conduits, raceways, surface raceways, gutters and wireways. The ground wire shall be bonded to each box to suitable lug, bus, or bushing. All bonding jumpers shall be routed inside conduit or raceway.

D. Provide an insulated isolated equipment grounding conductor in addition to the insulated equipment grounding conductor for all isolated grounding feeders, branch circuits, outlets and isolated grounding receptacles.

E. Provide all conduit terminating in switchgear, transformers, switchboards, panelboards and voice/data outlets with grounding bushings, where required, and ground wire extended to ground bus in equipment. Install grounding bushings where reducing washers are used and concentric and eccentric knock-outs are used.

F. Main bus and building grounding electrode conductor installation shall be witnessed by the Architect / Engineer.

G. Provide bonding to meet Regulatory Requirements.

H. Interface with lightning protection system when lightning protection system is specified.

I. Locate and install anchors, fasteners, and supports in accordance with NECA “Standard of Installation”.

J. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

K. Do not use spring steel clips and clamps.

L. Do not use powder-actuated anchors.

M. Do not drill or cut structural members.

N. Do not use compression or mechanical connectors underground.

O. Do not use sheetmetal or self-drilling screws for bonding connections. Provide listed or approved connectors.

P. Provide grounding access well for each driven ground electrode, not located in manholes or pull boxes.
   1. Access well top shall be flush with finish paved surfaces.
   2. Ground access wells located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.
   3. Provide thermal fusion (exothermic) connectors approved for direct burial.

3.2 METAL FRAME OF BUILDING OR STRUCTURE

A. Effectively ground the building steel or structure per NEC 250-52 (2).

3.3 UFER GROUND

A. Provide a UFER ground at bottom of building slab per NEC 250.52 (3), bond to building steel.

3.4 MISCELLANEOUS REQUIREMENTS

A. Continuity of the equipment grounding system shall be maintained throughout the project. Equipment grounding jumpers shall be installed across conduit expansion fittings, liquid-tight flexible metal and flexible metal conduit, and other non-electrically continuous raceway fittings.

B. Equipment grounding conductors and grounding electrode conductor shall be stranded copper conductors and run in a suitable raceway. Grounding conductors and grounding electrode conductor shall be continuous, without joints or splices over their entire length, except as allowed by NFPA 70/NEC.

C. For separately derived alternating current system grounds, bond the case and neutral of each transformer secondary winding directly to the nearest available effectively grounded structural metal member as required in NEC 250.

D. Exterior Electrical Equipment Racks:
   1. Provide driven ground electrode.

E. Technology/Data/Voice Communications, CATV, CCTV, and MATV Equipment Grounding: Provide grounding electrode conductor from the communications service equipment to the building grounding system as required. Grounding shall conform to ANSI/TIA/EIA 607(A) – Commercial Building Grounding and Bonding Requirements for Telecommunications, National Electrical Code®, ANSI/NECA/BICSI-568 and manufacturer's grounding requirements as minimum. Bonding shall be of low impedance to assure electrical continuity between bonded elements.
   1. MDF Closets Telecommunications Main Ground Bar (TMGB): Provide Erico #EGBA14424MM ground bar, wall mounted to the telecommunications plywood backboard. Provide one #3 AWG insulated ground conductor from ground bar to building steel. Provide #2/0 AWG insulated ground conductor to the building electrical service ground at the nearest electrical switchboard or panelboard.
   2. IDF Closets Telecommunications Ground Bar (TGB): Provide Erico #EGBA14410FF ground bar mounted to the telecommunications plywood backboard. Provide one #6 AWG insulated ground conductor from ground bar to building steel and to ground bus of nearest electrical panelboard or switchboard.
   3. Provide #2/0 AWG insulated ground conductor between each TMGB and all TGBs.
   4. Provide #2/0 AWG insulated ground conductor from TMGB to electrical service ground bus at main electrical service switch.
   5. Bond each equipment rack, cabinets, frames, together and with #6 AWG insulated ground conductor to the local TMGB / TGB. Bond and ground equipment racks, housings, messenger cables, raceways, and rack-mounted conduit.
   6. Route TMGB – TGB ground conductor using the shortest, straightest, route practical with long radius curves.
   7. All conduits terminating to cable trays, wireways, and racks shall be mechanically fastened. When connected to a cable tray or rack, it must be connected with

ground bushings, wire bonded to the tray or rack, and grounded to the main building grounding system or IDF room grounding bar using #6 AWG copper.

F. Ground lighting fixture bodies to the conduit grounding system.

G. Bond receptacle ground to the box and conduit ground system, except where and insulated/isolated grounding receptacle or outlet is specified.

H. Ground connections to building steel, grounding electrodes and all underground connections shall be by thermal fusion (exothermic).

I. Provide OZ Type “BJ” bonding jumper at all expansion joints, points of electrical discontinuity or connections in conduit where firm mechanical bond is not possible, such as flexible connections, insulating couplings, etc.

J. Ground each lighting and power panelboard by connecting the grounding conductors to the grounding stud.

K. Ground each secondary dry-type transformer to the ground bus of the primary side panelboard. Provide a bonding jumper between the ground stud and the neutral. Ground transformer ground stud to ground ring if a ground ring is installed or the nearest structural steel member.

L. Bond every item of equipment served by the electrical system to the building equipment ground system. This includes, but is not limited to, switchboards, panelboards, disconnect switches, receptacles, cable trays, controls, fans, air handing units, pumps and flexible duct connections.

M. Ground each light pole, power distribution poles, and metal conduit stub-ups at each light pole base.

N. Ground all metal conduit including metal conduit used for bends and penetrations through concrete.

O. Bond hot water and cold water piping together at each domestic water heater.

3.5 MANHOLE AND/OR PULL BOX GROUNDING

A. Provide a driven ground rod and ground bond ring in each power and telephone manhole or pull box. Bond cable racks and medium voltage cable shields at splices and terminations, ductbank conduit ground bushings and all other metal components in manholes or pull box to the ground ring.

3.6 COORDINATION

A. General: Coordinate installation of grounding connections for equipment with equipment installation work.

3.7 TESTING

A. Ground Resistance Test: Perform a ground resistance test for comparison to future inspection and testing data by the Owner. Test shall be performed using a Biddle Megger Earth Tester or equivalent test instrument. The test shall not be performed within 48 hours after the last rainfall.
   1. Inspect and test in accordance with NETA ATS except Section 4
   2. Grounding and Bonding: Perform inspections and tests listed in NETA ATS,

B. True Root Mean Square (RMS) AC measurements: The True RMS AC Measure test should be performed for all bonding conductors. The recommended maximum AC current value on any bonding conductor should be less than 1 ampere (A). The recommended maximum DC current value should be less than 500 milliamperes (mA). If abnormally high AC current levels are present on any bonding conductor, a dangerous faulty wiring condition likely exists within the room.

C. Two-Point Bonding Measurements: The Two-point Bonding test should be performed for all bonding conductors. This test should be performed using an earth grounding resistance tester configured for a continuity test. The test is performed by connecting the meter leads between the nearest available grounding electrode (e.g., structural steel) and the TMGB or TGB. The recommended maximum value for the bonding resistance between these two points is 0.1 Ohms (100 milliohms).

D. Submittals: Furnish instruments and personnel required for tests. Personnel shall be trained in all aspects of testing grounding systems and shall be formally trained on using all test equipment required. Submit 2 copies of certified test results for Owner's record and submit 4 copies of certified test results to Architect / Engineer for review. Test reports shall include date and time of tests, relative humidity, temperature, and weather conditions.

END OF SECTION

SECTION 26 05 33

CONDUIT SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install a complete system of electrical conduits and fittings.

1.2 REFERENCE STANDARDS

A. National Electrical Code.

B. Local codes and ordinances.

C. UL.

D. ETL.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – Provide products manufactured in the USA

A. Raceways:
1. Allied, International Metal Hose, Ipex, Heritage Plastics, Wheatland, Can-Tex, Carlon, Certain-Teed, Anamet, Inc., Electri-Flex Co., Western Tube and Conduit, Sentinel Conduit.
2. PVC Coated RGC: Robroy Perma Cote, Robroy Plasti-Bond, or Calbond – no exceptions.
3. Stainless Steel: Robroy, Calbrite, Gibson.
4. Aluminum: Penn Aluminum, American Conduit, Wheatland, Eaton B-Line, Patriot Aluminum Products.
5. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass, United Fiberglass.

B. Fittings:
1. Appleton, Crouse Hinds, Topaz, Steel City, O.Z. Gedney, Carlon, Heritage Plastics, Raco, Ipex, International Metal Hose, Lew Electric Fittings Co.
2. PVC Coated ferrous fittings: Robroy Perma Cote, Robroy Plasti-Bond, or Calbond – no exceptions.
3. Stainless Steel: Robroy, Calbrite, Gibson, Crouse Hinds.
4. Aluminum: Penn Aluminum, American Conduit, Wheatland, Eaton B-Line, Patriot Aluminum Products.
5. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass.

C. Condulets and Conduit Bodies:
1. Appleton, Form 85.
2. PVC Coated: Robroy Perma-cote or Plasti-Bond, – no exceptions.
3. Stainless Steel: Robroy, Calbrite, Gibson, Crouse Hinds.
4. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass.

D. Steel MC Cable for light fixture whips:
1. AFC.

2. Southwire.
3. General Cable.
4. Kaf-Tech.

2.2 GENERAL

A. The minimum conduit size shall be ¾-inch unless indicated otherwise in Divisions 26, 27 or 28.
1. Branch Circuits: Minimum conduit size shall be ¾-inch.
2. Feeder Circuits: Minimum conduit size shall be ¾-inches.
3. Technology, telecommunications, and low voltage systems: The minimum conduit size shall be ¾-inches unless noted or indicated otherwise.
4. The minimum conduit size between buildings for technology, voice, data, fire alarm, video, security, surveillance, BMCS, and other telecommunications shall be 2-inch unless indicated otherwise.

B. The minimum conduit size for flexible metallic conduit for tap connections to individual light fixtures shall be ½ inch, or steel metal clad (MC) cable with insulated ground conductor maximum 6 feet.

C. Electrical nonmetallic tubing, flexible polyethylene or PVC tubing shall not be used on this project.

D. BX and AC cable shall not be used on this project.

E. PVC elbows shall not be used on this project.

F. Intermediate metal conduit (IMC) shall not be used on this project.

2.3 RIGID METAL CONDUIT

A. UL labeled, Schedule 40:
1. Mild steel pipe, zinc coated inside and out.
2. Aluminum Alloy 6063, T-1 temper.
3. Threaded ends.
4. Insulated bushings.

B. Fittings shall meet the same requirements as rigid metal conduits.
1. UL labeled.
2. Threaded fittings.

2.4 ELECTRICAL METALLIC TUBING (EMT)

A. UL labeled, standard weight:
1. Cold rolled steel tubing, zinc coated inside and out.
2. Aluminum Alloy 6005, 6063. Temper T-1.

B. Fittings shall meet the same requirements as EMT conduits.
1. UL labeled.
2. Insulated throat connectors.
3. Steel fittings with setscrews with lock nuts on threaded ends, no snap locks.
4. Cast metal fittings are not approved.
5. Uni-couple type connectors are not approved.
6. Split ring, anti-short bushings are not approved.

2.5 RTRC CONDUIT FITTINGS AND CONDUIT BODIES

A. UL listed.

B. Standard wall thickness sizes ¼-inch through 4-inch.

C. Underground medium wall thickness sizes 5 and 6-inch.

D. Conduit interface joints above grade, gasket joint below grade.

E. Extra heavy wall for above ground and/or UL Class 1 Division 2 and Class 1 Zone 2 applications.

2.6 PVC COATED RIGID STEEL WITH URETHANE INTERIOR COATING

A. The PVC coated galvanized rigid conduit and fittings must be ETL Listed and Verified. The PVC coating must have been investigated and verified by ETL as providing the primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations must be ETL Listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating must be UL listed for the hazard conditions to which they are to be used. All conduit and fittings must be new, unused material. Applicable UL standards may include UL 6 Standard for Safety, Rigid Metal Conduit, and UL514B Standard for Safety, Fittings for Conduit and Outlet Boxes.

B. The PVC coated galvanized rigid conduit and fittings must be ETL Verified to the Intertek ETL SEMKO High Temperature H_2O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.

C. The conduit shall be hot dip galvanized inside and out with hot galvanized threads.

D. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.

E. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating from tool damage during installation.

F. Form 8 Condulets, ½-inch through 2-inch diameters, shall have a tongue-in-groove gasket to effectively seal against the elements. The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 inches of mercury (vacuum) for 72 hours shall be available.

G. Form 8 Condulets shall be supplied with plastic encapsulated stainless-steel cover screws.

H. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness. Conduit or fittings having areas with thin or no coating shall be unacceptable.

I. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30°F (-1°C).

J. All male threads on conduit, elbows and nipples shall be protected by application of a urethane coating.

K. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.

L. Independent certified test results shall be available to confirm coating adhesion under the following conditions
   1. Conduit and condulet exposure to 150°F (65°C) and 95% relative humidity with a minimum mean time to failure of 30 days. (ASTM D1151)
   2. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test (ASTM D3359).
   3. No trace of the internal coating shall be visible on a white cloth following six wipes over the coating which has been wetted with acetone (ASTM D1308).
   4. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.

M. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit. All U bolts shall be provided with plastic encapsulated nuts that cover the exposed portions of the threads.

N. All fittings, clamps, straps, struts, and hardware used with PVC coated conduit shall be PVC coated or 316 stainless steel.

2.7 STEEL FLEXIBLE CONDUIT

A. Steel flexible metallic conduit:
   1. Zinc coated inside and out.
   2. 18-inches minimum length, 24-inches maximum length.

B. Steel flexible metallic conduit for tap connections to light fixtures where steel MC Cable fixture whips are not used:
   1. 18 inches minimum length; 6 feet maximum length.

C. Liquid tight flexible steel conduit
   1. Type L.A. - Grounded - UL Approved.
   2. 18-inches minimum length, 24-inches maximum length.

2.8 PVC CONDUIT

A. UL labeled Schedule 40 and Schedule 80.

B. PVC fittings and solvent welded joints.

C. Acceptable PVC condulet manufacturer: Ipex, Cantex .

2.9 CONDULETS AND CONDUIT BODIES

A. UL Labeled.

B. Form 85.

C. PVC Coated: Form 8.

D. LBC Condulets shall be used for size 2 inch and above.

E. LL and LR Condulets shall not be used for 2 inch and above.

2.10 ROOF MOUNTED CONDUIT AND BOX SUPPORTS

A. Conduit supports and pads suitable for direct sunlight, conduit size, weight, quantity and roof system with unistrut supports and accessories. Conduit supports shall allow for conduit expansion and contraction.

B. Refer to roofing specifications for additional information. The limitations and restrictions contained in any roofing specification shall prevail and supercede these specifications for roof mounted supports for conduits and boxes.

C. Approved Manufacturer:
1. Portable Pipe Hangers.
2. Eaton B-Line.
3. Miro Industries, Inc.

2.11 ALUMINUM CONDUIT

A. UL Labeled.

B. Aluminum fittings shall meet the same requirements of aluminum conduits, compatible steel fittings.
1. UL Labeled for use with aluminum conduit.

2.12 STAINLESS STEEL CONDUIT

A. UL Labeled

B. Rigid Stainless Steel:
1. Type 304 Stainless Steel.
2. Threaded ends.
3. Insulated Bushings.

C. EMT:
1. Type 304 Stainless Steel.
2. Compression Fittings.
3. Insulated Bushings.

D. Fittings, elbows, nipples, strut, device box, clamps straps, etc.
1. Type 304 Stainless Steel.

2.13 ELECTRICAL NON-METALLIC TUBING (ENT)

A. UL labeled Schedule 40.

B. PVC fittings and solvent welded joints.

C. Acceptable manufacture: Carlon.

2.14 EXTERIOR IN-GRADE PULL BOXES

A. Enclosures, boxes and covers are required to conform to all test provisions of the most current American Association of State Highway and Transportation Officials (AASHTO) standards for H-20 loading applications.
1. AASHTO H-20 certified precast concrete, cast iron or other AASHTO recognized

materials, rated for deliberate traffic.
2. Conduit entry knock-outs as required.
3. Bolt down galvanized steel/cast iron covers.
4. Thin wall knocks outs as required .
4. Integral bottom.
5. Box height as required for specified conduit depth and required top elevation.
6. Concrete design strength of minimum 5,500 PSI at 28-days.
7. Place enclosures on a minimum of 6 inches of coarse gravel with a border of 6-inches beyond the enclosures exterior dimension.
8. Size and volume as required for application.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install electrical conduits and fittings for all wiring of any type unless specifically specified or instructed to do otherwise. Install conduits and fittings in accordance with local codes and applicable sections of the NECA “Standard of Installation”, concealed where possible.
1. Fasten conduit supports to building structure and surfaces; do not support to roof deck.
2. Arrange supports to prevent misalignment during wiring installation.
3. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
4. Do not attach conduit to ceiling support wires.
5. Arrange conduit to maintain head room and present neat appearance.
6. Maintain 4-inch clearance between conduit and rooftop surfaces.
7. Cut conduit square using saw or pipe cutter; de-burr cut ends.
8. Bring conduit to shoulder of fittings; fasten securely.
9. Conduit penetrations to all individual motor controllers, VFDs, and motor control cabinets shall only be made at the bottom of the enclosure. For other equipment, provide listed water sealing conduit hubs to fasten conduit to sides or tops of electrical equipment enclosures, device box, gutter, wireway, disconnect, etc.
10. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
11. Ground and bond conduit as required.
12. Identify conduit as required.
13. Route all conduits above building slab perpendicular or parallel to building lines.
14. Do not use no-thread couplings and connectors for galvanized steel, PVC coated galvanized steel, or aluminum rigid conduit.

B. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.

C. In areas where raceway systems are exposed and acoustical or thermal insulating material is to be installed on walls, partitions, and ceilings, raceways shall be blocked out proper distance to allow insulating material to pass without cutting or fitting. Also provide Kindorf galvanized steel channels to serve as standoffs for panels, cabinets and gutters.

D. Securely fasten conduits, supports and boxes, to ceiling (not roof deck), walls, with Rawl Plugs or approved equal anchors. Use lead cinch anchors or pressed anchors. Use only cadmium plated or galvanized bolts, screws. Plastic anchors and lead anchors shall not be used for overhead applications.

E. Provide separate raceway systems for each of the following when specified, indicated or required:

1. 120/208 volt circuits.
2. 277/480 volt circuits.
3. Emergency
    a. Life safety branch.
    b. Critical branch.
    c. Equipment branch.
4. Voice/Data.
5. Sound reinforcement.
6. Theatrical and Architectural Dimming Controls.
7. MATV/CATV.
8. Security CCTV.
9. Security System.
10. Communications / PA Systems / Sound System Line Input and Speakers.
11. Fire Alarm.
12. Lighting Control Systems.
13. Building Management Control Systems.

F. Unless shown otherwise, do not install conduit in or below concrete building slabs.

G. Unless shown otherwise, do not install conduit horizontally in concrete slabs.

H. Roof penetrations shall be made in adequate time to allow the roofing installer to make proper flashing. Conduit for equipment mounted on roof curbs shall be routed through the roof curb. Conduit, gutters, pull boxes, junction boxes, etc. shall not be routed on roof unless specified otherwise. Where specifically indicated to be routed or mounted on the roof, supports shall be as specified, as recommended by roofing manufacturer and roof support manufacturer and as required by NEC. Place supports every five feet along conduit run and within 3 feet of all bends, condulets, and junction boxes. Provide roofing pad under stands at directed by Architect and as recommended by roofing manufacturer and roof support manufacturer. Provide additional unistrut supports and accessories as required.

I. PVC coated conduit shall have all nicks and cuts to the protective coating repaired using manufacturer’s approved touch-up material as recommended by manufacturer. Provide a minimum of two-wraps of 3M-50 type tape over touch-up.

J. Installation of the PVC Coated Conduit System shall be performed in accordance with the Manufacturer’s Installation Manual. To assure correct installation, the installer shall be certified by Manufacturer to install coated conduit. Submit copies of training certification with submittal. Contractor shall coordinate installation with manufacturer’s representative for field training and observation of installed PVC coated rigid galvanized conduit and fittings. Manufacturer’s representative shall certify the installation is in accordance with manufacturer’s installation instructions. Submit copies of installation certification prior to cover-up of underground installation.

K. All conduit terminations at locations including but not limited to, switchgear, pull boxes, outlet boxes, stub-up, and stub-outs:
1. Provide insulated throat connectors for EMT conduits.
2. Provide insulated bushing on all rigid conduit terminations.
3. Provide locknuts inside and outside of all boxes and enclosures.
4. Provide threaded type plastic bushing at all boxes and enclosures.

L. In suspended ceilings, support conduit runs from the structure, not the ceiling system construction.
1. Do not support from structural bridging.
2. Do not support from metal roof deck.

M. Completely install each conduit run prior to pulling conductors. All boxes are to be accessible after completion of construction.

N. All conduits must be kept dry and free of water or debris with approved pipe plugs or caps. Cap or plug conduit ends prior to concrete pours.

O. Ream ends of conduits after cutting and application of cutting die to remove rough edges.

P. Install all above concrete slab conduits perpendicular or parallel to building lines in the most direct, neat and workmanlike manner.
   1. Cable Tension:
      a. 0.008 lb./cmil for up to 3 conductors, not to exceed 10,000 pounds.
      b. 0.0064 lb./cmil for more than 3 conductors, not to exceed 10,000 pounds.
      c. 1000 lbs. per basket grip.
   2. Sidewall pressure: 500 lbs./ft.
   3. Conduit runs within the following limits of bends and conduit length between pull points shall not exceed the above installation pulling tension and sidewall pressure limits.
      a. Three (3) equivalent 90-degree bends: not more than fifty feet (50') between pull points.
      b. Two (2) equivalent 90-degree bends: not more than one hundred feet (100') between pull points.
      c. One (1) equivalent 90-degree bend: not more than one hundred fifty feet (150') between pull points.
      d. Straight pull: not more than two hundred feet (200') between pull points.
   4. Indicate sizes of conduits, wireway sections, and cable tray sections on the as-built drawings.
   5. Hold horizontal and vertical conduits as close as possible to walls, ceilings and other elements of the building construction. Conduits shall be kept a minimum of 6 inches clear of roof deck / insulation, and 2 inches clear of above floor deck / insulation.
   6. Install conduits to conserve building space and not obstruct equipment service space or interfere with use of space. Conduit shall not be routed on floors, paved areas or grade.
   7. Where a piece of equipment is wired from a switch or box on adjacent wall, the wiring shall go up the wall from the box, across at or near the ceiling, and back down to the equipment. Wiring shall not block the walkway between wall and equipment.
   8. Horizontal runs of conduit on exposed walls shall be kept to a minimum.
   9. Conduit for mechanical / plumbing equipment installed outdoors shall be routed with the associated mechanical / plumbing pipe support rack system where practical, coordinate with Divisions 22 and 23.
   10. Conduits installed in public areas, not concealed by architectural ceilings, shall be supported by galvanized steel channel racks to bottom of roof deck or floor deck. Conduits shall be grouped for neat workman-like appearance.

Q. Install expansion and deflection fittings and bonding jumpers on straight runs which exceed 200-feet, on center, and at 200-feet maximum, on center, on straight runs which exceed 400-feet, and where conduits cross building expansion joints.

R. Provide grounding bushings at concentric/eccentric knockouts or where reducing washers are used.

S. Run conduit to avoid proximity to heat producing equipment, piping surfaces with

temperatures exceeding 104 degrees F., and flues, keeping a minimum of 13-inches clear.

T. Install conduit as a complete system, without conductors, continuous from outlet to outlet and from fitting to fitting. Make up threaded joints of conduit carefully in a manner to ensure a tight joint. Fasten the entire conduit system into position. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of four quarter bends, including those bends located immediately at the outlet or fitting.

U. Conceal conduit systems in finished areas. Conduit may be exposed in mechanical and electrical rooms, and where otherwise shown or indicated only. Run the conduit parallel and perpendicular to the structural features of the building and support with malleable iron conduit clamps at intervals as required by NEC or on conduit racks, neatly racked and bent in a smooth radius at corners.

V. Conduit bends shall be factory elbows or shall be bent using equipment specifically designed to bend conduit of the type used to maintain the conduit's UL listing. Conduit hanger spacing shall be 10 feet or less and as required by the NEC for all conduit. Beam clamp attachments to steel joist chords is prohibited. Beam clamps may only be used at beams, no exceptions. Connections to joists shall be made with galvanized channel extended between joist chords or with galvanized channel bearing on the vertical legs of joist chord angles.

W. Support conduit on galvanized channel, using compatible galvanized fittings (bolts, beam clamps, and similar items), and galvanized threaded rod pendants at each end of channel and secure raceway to channel and channel to structure. Where rod pendants are not used, channel supports are to be secured to structure at each end. Conduit supports are to be secured to structure using washers, lock washers, nuts and bolts or rod pendants; use of toggle bolt "wings" are not acceptable. Support single conduit runs using a properly sized galvanized conduit hanger with galvanized closure bolt and nut and threaded rod. Raceway support system materials shall be galvanized and manufactured by Kindorf, Unistrut, Superstrut, Caddy, or Spring Steel Fasteners, Inc. Provide chrome or nickel-plated escutcheon plates on conduit passing through walls and ceilings in finished areas. Do not support conduit from other conduit, structural bridging or fire rated ceiling system. Do not support more than one conduit from a single all-thread rod support. Provide electrical insulating sleeve or wrapping for aluminum conduit supported by zinc coated supports or fasteners. Channel supports shall have cut ends filed smooth. When installed outside of the building, or in areas subject to moisture, the cut ends shall be painted with ZRC galvanized paint or equivalent.

X. Terminate all motor connection conduits in mechanical room spaces with a floor pedestal and with "Tee" conduit at motor outlet height for flexible conduit.

Y. Where conduit is not embedded in concrete or masonry, conduit shall be firmly secured by approved clamps, half-straps or hangers. Tie wire and short pieces of conduit used as supports and or hangers are not approved.

Z. Where "LB" condulets are used, 2-inches and larger shall be type "LBD".

AA. No more than 12 conduits containing branch circuits may be installed in junction boxes, pull boxes or gutters.

BB. Flexible metal conduit and liquid tight flexible metal conduit shall only be used for final connections from junction box to equipment, light fixtures, power poles, etc. They are not to be used in lieu of conduit runs. They shall not be used for wall or roof penetrations

unless they are installed in a PVC coated RGC conduit sleeve at least one size larger than the OD of the flexible conduit.

CC. Where 3-1/2-inch conduit is specified and the required or specified material is Schedule 80 PVC, provide 4-inch conduit.

DD. “Daisy Chaining” light fixtures installed for lay-in ceiling areas is not allowed. Each light fixture shall have its own fixture whip from junction box. The only exception being light fixtures installed end to end using chase nipples between them, or light fixtures recessed in non-accessible ceilings.

EE. In above ceiling applications, do not install raceways, junction boxes, gutters, disconnects, etc. within 36 inches directly in front of HVAC control boxes or other equipment requiring access from a point starting from the top of control box / equipment down to ceiling.

FF. Do not install conduit, junction boxes, etc. within 18 inches of outside edges of roof access openings.

GG. Install minimum size 2-inch nipple, at least one, between multi-sectional panels for branch circuit independent of feeder conductors.

3.2 CONDUITS

A. Conduit above grade indoors:
   1. Concealed Conduits: EMT with set screw fittings
   2. Exposed conduits:
      a. Below nine feet AFF where not directly attached and against building walls, ceiling, or structure: Rigid metal conduit or x-wall RTRC.
      b. Where subject to physical damage: Rigid metal conduit or x-wall RTRC.
      c. Wet locations: PVC coated galvanized rigid steel or aluminum conduit
      d. Damp Locations: Aluminum rigid conduit or x-wall RTRC.
      e. Exposed conduits in mechanical rooms or electrical rooms shall be rigid galvanized steel or x-wall RTRC when installed below 18-inches above finished floor.

B. Conduit installed above grade outdoors:
   1. Galvanized rigid steel or x-wall RTRC for conduits up utility poles and where subject to physical damage or where located less than four feet above finished floor.
   2. Aluminum or x-wall RTRC where not subject to physical damage and where located four feet above finished floor.

C. Conduit where indicated underground:
   1. PVC Coated Galvanized rigid steel or RTRC conduit elbows and Schedule 80 PVC, RTRC, or PVC coated galvanized steel straight run conduits. PVC conduits for underground branch circuits shall be Schedule 80 or Schedule 40 PVC.
      a. PVC conduit and fittings shall be used only for straight horizontal runs and for vertical risers at site lighting pole bases. Bending straight sections of PVC conduit to less than 25-foot radius or the use of PVC factory bends is not allowed.
      b. Change in direction of conduit runs, either vertical or horizontal, shall be with RTRC or PVC coated galvanized steel elbows or long sweep bends of straight PVC conduit sections. Long sweep bends of straight PVC 20-foot sections shall have a minimum radius of curvature of 25 feet and a maximum arc of 22.5degrees. Multiple long sweep bends of straight PVC

sections shall be separated by a minimum of 20-feet of straight, linear, PVC sections.

c. Provide RTRC or PVC coated rigid galvanized steel conduit elbows and fittings with urethane interior coating at all changes in direction with radius of less than 25-feet and at all vertical runs to 18 inches above finished floor elevation. For interior slab penetrations, provide continuous RTRC or PVC coated rigid galvanized steel conduit and fittings with urethane interior coating from change in direction to 18 inches above finished floor elevation, except where stubbed-up under and inside equipment or switchgear where conduit shall be terminated at minimum two inches above concrete housekeeping pad.

d. Elbows for underground electrical service entrance, feeders, transformer primary / secondary, telecommunication, and low voltage conduits shall be RTRC or PVC coated rigid galvanized steel with long radius as follows:
   1) Up to 1-inch conduit, minimum 12-inch radius.
   2) 1.5-inch conduit, minimum 18-inch radius.
   3) 2-inch conduit, minimum 24-inch radius.
   4) 2.5-inch conduit, minimum 30-inch radius.
   5) 3-inch conduit, minimum 36-inch radius.
   6) 3.5 to 6-inch conduit, minimum 48-inch radius.

e. Conduit for all floor boxes shall be routed below building slab from floor box to nearest column, wall, or as indicated.

f. Conduits shall not be routed horizontally in building slab, grade beams or pavement.

2. Encase all underground conduits in concrete.

   a. Concrete shall be tinted red throughout with a ratio of 10 pounds of dye per yard of concrete unless prohibited by utility for utility conduits. Concrete encasement for utility installed conductors shall be as specified by the utility and comply with their standards and specifications. Where utility does not require but allows concrete encasement of conduits, provide concrete encasement as specified herein.

   b. Provide minimum 3-inch concrete encasement around conduits.

   c. Provide conduit spacers for parallel branch/feeder conduits.

   d. When prior written approval from Owner and Architect to omit concrete encasement of conduits below building slab is given, conduits either specified or approved in writing to be routed under building slab without concrete encasement for electrical branch circuits or voice / data / video / communications horizontal drops or outlets shall be installed 18 inches below finished floor and on select fill. All other conduits, including but not limited to electrical feeders, voice / data / video / communications vertical, riser, tie, trunk, or service cable conduits shall be installed 48-inches below finished floor and on select fill.

   e. Use suitable manufactured separators and chairs installed 4 feet on centers. Securely anchor conduit at each chair to prevent movement during backfill placement.

3. Install building voice / data / video / communications main service conduits and electrical service transformer primary and secondary conduits with top of concrete encasement minimum 48-inches below finished grade or pavement. Voice / data / video / communications conduits and electrical service primary conduits for utility owned electrical service transformers shall also comply with the respective utility company requirements and standards. All other underground conduits outside of building other than voice / data / video / communications main service conduits and electrical service transformer primary and secondary conduits shall have top of concrete encasement at 36 inches minimum below finished grade or pavement.

4. Provide two “caution” plastic tapes at 6-inches and 18-inches below finished slab, grade, or pavement; identify as specified in Section 26 05 00.
5. Conduits located outside building, provide magnetic locator tape at top of first compacted layer of backfill or concrete.
6. During construction, partially completed underground conduits shall be protected from the entrance of debris such as mud, sand, and dirt by means of conduit plugs. As each section of the underground conduit is completed, a testing mandrel with diameter ¼-inch smaller than the conduit, shall be drawn through each conduit. A brush with stiff bristles shall be drawn through until conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.
7. Utility underground conduit for Utility Company cable shall be installed per Utility Company standards, and their specifications for this project.
8. Concrete shall be Portland Cement conforming to ASTM-C-150, Type 1, Type III or Type V if specified. Cement content shall be sufficient to product minimum strength of 2,500 PSI.
9. Contractor shall stake out routing and location of underground conduits using actual field measurements. He shall obtain approval of the Owner and Architect before beginning trenching, horizontal drilling, and excavation.
10. Verify location and routing of all new and existing underground utilities with the Owner and Architect on the job site. Stake out these existing utilities so that they will not be damaged. Stake out new utilities to provide coordination with other trades and with new and existing utilities, easements, property lines, restricted land use areas, and right-of-ways. Verify existing public utilities with Call811.

D. Conduit shown in concrete walls, floor or roof slab:
   1. PVC Coated Galvanized Rigid steel.

E. Conduits that penetrate concrete slab, or within 100 feet of cooling towers, or at designated corrosive locations.
   1. RTRC.
   2. PVC coated galvanized rigid steel.

F. Connections to equipment mounted on roof, rotating equipment, transformers, and kitchen or food processing equipment, or where flexible conduit is required outdoors.
   1. Liquid tight flexible metal conduit (1/2 inch may be used for roof top supply / exhaust fans only).
   2. Liquid tight flexible metal conduit for 24-inch maximum length.
   3. Conduit for roof-mounted equipment shall be routed inside the roof curb assembly roof opening. Provide permanent lock-off device at panelboard circuit breakers serving roof equipment and accessories to enable tag-out procedures for all power routed through roof curb and to the roof mounted equipment and accessories.

G. Light fixture whips:
   1. Accessible ceilings and open structure: ½-inch flexible steel conduit or steel MC cable, length not to exceed 6-feet.
   2. Non-accessible ceilings: ½-inch flexible steel conduit. Length as required to make a tap at an accessible j-box. Recessed light fixtures in non-accessible ceilings may be daisy chained using the light fixture’s integral, UL listed j-box or internal wire way that is accessible through fixture from below the ceiling.
   3. Dedicated insulated ground wire.
   4. Light fixture whips shall not rest on ceiling grid or tile.
   5. Light fixture whips shall not be supported from the ceiling suspension system. Support from the structure with #13 AWG galvanized iron wire pendants and Caddy clips. Do not support conduit from structural bridging. Flexible conduit and steel MC cable shall be kept a minimum of 2 inches clear of roof deck.

H. Conduits at Natatorium or therapeutic pool areas:
   1. Underground conduit shall be as specified in this section.
   2. Exterior conduits and boxes within 100 feet of exhaust openings shall be x-wall RTRC or PVC coated galvanized rigid steel or stainless steel.
   3. Exposed conduits in chemical storage rooms, pool mechanical equipment (pump rooms, and pool equipment storage rooms shall be Schedule 80 PVC. Boxes shall be PVC, or 304 Stainless Steel.
   4. Exposed conduits and boxes in indoor pool areas and all other indoor public areas shall be Type 304 Stainless Steel.

I. Conduits located inside greenhouses and natatorium pump and water treatment rooms:
   1. X-wall RTRC.
   2. Schedule 80 PVC.
   3. PVC coated galvanized rigid steel conduit and fittings.

J. Conduits in classified hazardous (Classified) locations:
   1. Conduit fittings and seals UL listed for the classification.

K. Conduits embedded in parking structure traffic wearing surface and concrete support structures:
   1. Schedule 40 PVC, RTRC, PVC coated rigid galvanized conduit.
   2. Schedule 40 ENT may only be used for flat runs embedded in traffic wearing surface concrete topping.
   2. Solvent welded fittings only for PVC conduit and ENT.
   3. Verify with Structural Engineer prior to construction for any additional limitations for raceway installation restrictions installed in parking structure including but not limited to maximum outside diameter of raceways permitted to be used in the wearing surface, and field cutting or drilling through parking structure structural members or support structures.
   4. All raceways shall be securely fastened to prevent floating during concrete installation. ENT raceways shall be completely embedded in concrete material to maintain fire and smoke integratory as required by the NEC.
   5. When using ENT or PVC conduits, provide transition to x-wall RTRC or PVC coated rigid galvanized conduit elbows and vertical risers to ensure that only flat horizontal runs of PVC conduit or ENT are used along the top of the parking structure structural support deck and that they are completely concealed and embedded by the wearing surface concrete material topping.

3.3 CONDUIT PENETRATIONS, SLEEVES AND ESCUTCHEONS

A. Furnish sleeves for placing in construction for all conduit passing through concrete or masonry walls, partitions, beams, all floors other than grade level, and roofs. A conduit sleeve shall be one size larger than the size of conduit, which it serves except where larger sizes are required for manufactured water, fire, or smoke stop fittings.
   1. Sleeves set in concrete floor construction shall be minimum Schedule 40 galvanized steel.
   2. Sleeves shall extend 3-inches above the finished floor.

B. Sleeves in concrete or masonry walls shall be RTRC or Schedule 40 galvanized steel. Sleeves shall be set flush with finished wall.

C. Install manufactured UL listed water, fire, and smoke stop fittings, or caulk around conduit or cables in sleeves with sufficient UL listed fire safe insulation or foam to maintain wall or floor slab fire or smoke rating. Refer to Architecture drawings for locations of rated walls.

D. Provide Linkseal Mechanical Seals around conduit penetrations through walls below grade. Provide a pull box to install a water stop inside wall penetration. Internally seal low voltage cabling conduit penetrations with waterproof caulking.

E. Sleeves penetrating walls below grade shall be Schedule 40 black steel pipe with ¼-inch thick steel plate secured to the pipe with continuous fillet weld. The plate shall be located in the middle of the wall and shall be 2-inches wider all around than the sleeve that it encircles. The sleeve should extend a minimum of 24-inches on either side of the penetration. The entire assembly shall be hot-dipped galvanized after fabrication. Do not sleeve or penetrate grade beams.

F. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with a threaded steel bushing. Route conduit through roof openings, for piping and ductwork or through suitable roof jack, with pitch pocket. Coordinate location with roofing installation as required.

G. Conduit passing through fire rated wall shall be sealed with Fire Stop. Route conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.

3.4 POWER DISTRIBUTION UNDERGROUND FEEDER CONDUIT AND UNDERGROUND SERVICE ENTRANCE CONDUIT

A. Power underground feeder and service entrance shall be of individual conduit encased in concrete. Unless shown otherwise, the type of conduit used shall not be mixed in any one underground conduit and shall be the size indicated on the drawings. The concrete encasement surrounding the underground conduit shall be rectangular in cross-section, having a minimum concrete thickness of 3-inches, except that conduit for 120V and above shall be separated from control and signal conduits by a minimum concrete thickness of 3-inches. Encasement concrete shall be tinted in red.

B. During construction, partially completed underground conduits shall be protected from the entrance of debris such as mud, sand, and dirt by means of conduit plugs. As each section of the underground conduit is completed, a testing mandrel shall be drawn through until each conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.

C. Furnish the exact dimensions and location of power underground conduit to be encased in time to prevent delay in the concrete work.

D. Conduit for service entrance underground conduits shall be as indicated on the drawings.

E. Primary power underground conduit shall be installed in accordance with utility company standards and the utility company specifications for this project.

3.5 TELECOMMUNICATIONS, LOW VOLTAGE AND EMPTY CONDUIT SYSTEM RACEWAYS

A. Conduit shall be installed in accordance with the specified requirements for conduit and with the additional requirements that no length of run shall exceed 100-feet for 1 inch or smaller trade sizes and shall not contain more than two 90-degree bends or the equivalent. Pull or junction boxes shall be installed to comply with these requirements. Provide plastic bushings at all conduit terminations. Provide a grounding bushing on each data and voice conduit.

B. Conduits shall be installed from outlet box to above an accessible ceiling. All cables routed through open spaces (no-ceiling below roof deck or above floor deck) shall be

routed in conduit. Telecommunications systems, CATV, CCTV, fire alarm and BMCS cables can be installed above accessible ceilings without conduit. Cables installed above accessible ceiling shall be plenum rated. Conduit rough in of these cables shall include a 90-degree turn-out to an accessible location with insulated bushings on the end of the conduit.

1. Provide conduit from each telecommunications outlet box to accessible ceiling plenum.
2. Provide conduit from each security / surveillance device outlet box to accessible ceiling plenum.
3. Provide two conduits for each multi-media outlet box and each outlet box indicated to contain more than four data, audio, or video drops to accessible ceiling plenum.
4. Provide the following minimum conduits for telecommunications and multi-media wall, floor, and ceiling mounted outlet boxes. Use the largest diameter conduit indicated below unless instructed otherwise in writing from the Architect:
    a. Non-masonry outlet box: Two 1-inch conduits.
    b. Masonry outlet box: Two 1-inch conduits, or three 3/4-inch conduits.
    c. Where indicated differently on plans or where conflicts arise, notify the Architect / Engineer prior to installation.

C. All conduit in which cable is to be installed by others shall have pull string installed. The nylon pull string shall have not less than 200 lb. tensile strength. Not less than 12-inches of slack shall be left at each end. Provide blank cover plate before substantial completion if box is for a future installation after substantial completion of the project. Conduit shall extend to a minimum six inches above nearest accessible ceiling and be turned horizontally with plastic bushing at terminations.

D. Conduits for Building Entrance Facilities:
1. Underground Outside Plant: Install a pull box every 300-feet or after 180 degree turns.
2. Inside Plant: Install a pull box every 150-feet or after 180 degree turns. All turns shall be large sweeps, not sharp 90s, with the radius of the sweep at least 10X the diameter of the conduit. Hence, a 4-inch conduit requires a 40-inch minimum radial sweep. If field conditions absolutely mandate a sharp 90-degree bend to be installed, then a pull box shall be installed at that location regardless of distance.
3. Building entrance facilities shall not terminate in an IDF or any other space except the MDF.
4. Coordinate the termination location of the building entrance facilities in the MDF with the room layout and equipment configuration.
5. Provide 4-inch conduit unless indicated otherwise. Provide (3) fabric innerducts in each 4-inch conduit.

3.6 EXTERIOR IN-GRADE PULL BOXES

A. Provide pull boxes where specified and as required.

B. Pull boxes located in pavement shall be set with proper extensions so that top of cover is flush with pavement.

C. Pull boxes located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.

3.7 ALUMINUM ALLOY CONDUCTORS

A. Where aluminum alloy conductors are specified, approved and substituted for copper conductors, provide the required conduit size based on conduit fill using NEC or recognized cable manufacturer's conduit fill tables for aluminum alloy compact conductors.

3.8 IDENTIFICATION

A. Conduit Systems: Provide adequate marking of conduit larger than one inch exposed or concealed in interior accessible spaces to distinguish each run as either a power (120/208V or 277/480V) or signal / telecommunication conduit (Fire Alarm, BAS, BMCS, Security, CCTV, Access Control, Intrusion Detection, Telecom, etc.). Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Locate markers at ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors or enters non-accessible construction, and at spacing of not more than 50-feet along each run of exposed conduit. Switch-leg conduit and short branches for power connections need not be marked, except where conduit is larger than 1-inch.

END OF SECTION

SECTION 26 05 35

ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Electrical connections as required and scheduled, and as specified.

1.2 RELATED WORK

A. Refer to other Divisions for specific individual equipment electrical requirements.

1.3 QUALITY ASSURANCE

A. UL Label: Products shall be UL listed to the extent possible.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General: For each electrical connection indicated, provide a complete assembly including, but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories needed to complete splices and terminations.

B. Raceways: Refer to related sections.

C. Conductors and Connectors: Refer to related section. Conductors at equipment terminations shall be copper.

D. Terminals: Provide electrical terminals as indicated by the terminal manufacturer for the application.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS

A. General: Install electrical connections as shown, in accordance with applicable portions of the NECA Standard of Installation, and industry practices.

B. Conductors: Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Where possible, match conductors of the electrical connection for interface between the electrical supply and the installed equipment.

C. Splice Insulation: Cover splices with electrical insulation equivalent to, or of a higher rating than, insulation on the conductors being spliced.

D. Appearance: Prepare conductors by cutting and stripping covering, jacket, and insulation to ensure a uniform and neat appearance where cables and wires are terminated.

E. Routing: Trim cables and wires to be as short as practical. Arrange routing to facilitate inspection, testing, and maintenance.

F. Motor Connections: Where possible, terminate conduit in conduit boxes at motors. Where motors are not provided with conduit boxes, terminate the conduit in a suitable condulet, and make motor connections. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with an approved grommet. For all AHU or fan motors and all other motors 10 HP and larger, at the motor connection do not use wire nuts. Provide copper alloy split bolt connectors or compression lugs and bolts. Insulate connection with Scotch Super 88 vinyl electrical tape over rubber tape, or Tyco Gelcap Motor Connection Kit.

G. Conduit connections to equipment including, but not limited to, Variable Frequency Drives, Manual and Automatic Transfer Switches, Surge Suppression Devices, motor controllers, electrical disconnects, food service / processing equipment, electronics, control panels and Owner furnished equipment:

1. Make conduit penetrations only at the bottom flat surface of the equipment and only where permitted by the equipment manufacturer to avoid un-intentional water entry. Coordinate installation of electrical connections for equipment with equipment installation work. Where equipment manufacture does not permit a bottom conduit entry, verify with Owner/Engineer and locate the conduit entry at the side surface as close as possible to the bottom of the enclosure.
2. Where conduit originates from an elevation above the conduit entry, provide a “T” condulet below the enclosure’s bottom elevation. Provide conduit from the condulet up to the enclosure bottom horizontal surface for electrical connection.

H. Identification: Refer to Electrical General Provisions for identification of electrical power supply conductor terminations with markers approved as to type, color, letter and marker size by the Architect. Fasten markers at each termination point, as close as possible to each connecting point.

I. Equipment and Furnishings: Refer to other Divisions. Coordinate power and control provisions shown for equipment and furnishings with the provisions required for the furnished equipment and furnishings. Where the power and control requirements are less than or equal to those specified, modifications to power and control provisions shall be made at no cost as a part of coordination. Where power and control requirements are in excess of those shown, notify the Architect in writing of the requirements.

J. Elevators and Escalators, and Wheelchair Lifts: Refer to Other Divisions. Coordinate power and control provisions shown with the provisions required for the furnished equipment. Where the power and control requirements are less than or equal to those specified, modifications to power and control provisions shall be made at no cost as a part of coordination. Where power and control requirements are in excess of those shown, notify the Architect in writing of the requirements. Provide lockable disconnect switches for main power, control power, lighting power, etc. as required by the NEC and all local codes. Provide all necessary means of two-way communication for emergency phones.

END OF SECTION

SECTION 26 05 37

ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide electrical box and fitting work as required, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

A. UL Label: Electrical boxes and fittings shall be UL listed.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS

A. Interior Outlet Boxes: Provide galvanized steel interior outlet wiring boxes, of the type, shape, and size, including depth of box, to suit respective locations and installation. Construct with stamped knockouts in back and sides. Provide gang boxes where devices are shown grouped. Single box design; sectional boxes are not acceptable, except for wall mounted electronic displays.
   1. Type of Various Locations:
      a. Wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations; recessed wall mounted box for power and/or multi-media (low voltage) outlets: Arlington Industries #TVBS 613, 4-gang steel box with white trim plate.
      b. Technology, data, voice, video and multi-media outlet boxes at locations other than wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations: minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes. Raco #260H large capacity box with ½ through 2-inch knockouts.
      c. Security, access control, and video surveillance outlet boxes: single gang, 3-inch deep outlet boxes mounted long axis vertically.
      d. All other applications: minimum 4-inch square (2-gang) 2-1/8-inch deep boxes.
      e. Masonry Walls: Galvanized switch boxes made especially for masonry installations; depths of boxes must be coordinated for each installation.
      f. Surface: Type FS or FD box with surface cover.
      g. Corrosive locations or natatorium areas: 316 stainless steel construction suitable for the installation.
      h. Hazardous (Classified) Locations: Explosion proof boxes, seals and fittings.
      i. Special: Where above types are not suitable, boxes as required, taking into account space available, appearance, and Code requirements
   2. Interior Outlet Box Accessories: Outlet box accessories required as for installation, including covers or wall device plates, mounting brackets, wallboard hangers, extension rings, plaster rings for boxes in plaster construction, fixture studs, cable clamps and metal straps for supporting outlet boxes. Accessories shall be compatible with outlet boxes used and meet requirements of individual wiring.

B. Damp Location Outlet and Damp or Wet Location Switch Boxes: Deep type, hot dipped galvanized cast-metal weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends, and stainless steel cover plate

with spring-hinged waterproof caps suitable for application. Include faceplate gasket and corrosion-resistant, tamper / vandal proof fasteners.

C. Wet Location Outlet Boxes: Hot dipped galvanized cast-iron weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends.

D. Junction and Pull Boxes: Galvanized sheet steel junction and pull boxes, with screw-on covers, of type, shape, and size, to suit respective location and installation.
   1. Type for Various Locations:
      a. Minimum Size: 4-inch square, 2-1/8-inches deep.
      b. 150 Cubic Inches in Volume or Larger: Code gauge steel with sides formed and welded, screw covers unless shown or required to have hinged doors. All boxes mounted above ceiling shall have screw covers. Boxes in all other areas with covers larger than 12-inches shall have hinged with screw covers. Knockouts factory stamped or formed in field with a cutting tool to provide a clean symmetrically cut hole.
      c. Exterior or Wet Areas: 304 stainless steel NEMA 4X construction with gaskets and corrosion-resistant fasteners.

E. Conduit Bodies: Provide galvanized cast-metal conduit bodies, of type, shape, and size, to suit location and installation. Construct with threaded conduit ends, removable cover, and corrosion-resistant screws.

F. Bushings, Knockout Closures, and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts, and insulated conduit bushings of type and size to suit use and installation.

G. Outlet boxes in fire rated walls: Provide 2-hour rated gasket within box and below cover, equal to Rectorseal Metacaulk box guard and cover guard.

PART 3 - EXECUTION

3.1 INSTALLATION OF BOXES AND FITTINGS

A. Install electrical boxes and fittings as shown and as required, in compliance with NEC requirements, in accordance with the manufacturer's written instructions, in accordance with industry practices.

B. Provide recessed device boxes for wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations.

C. Provide minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes for technology, data, voice, video, and multi-media outlet boxes at locations other than wall mounted interactive boards, video or visual displays. Provide single gang only, 3-inch deep outlet boxes mounted long axis vertically for security, access control, and video surveillance, coordinate with security equipment installation. Provide minimum 4-inch square (2-gang) 2-1/8-inch deep boxes for all other applications. Where indicated differently on plans or where conflicts arise, notify the Architect / Engineer prior to installation. Box extenders or plaster rings shall not be used to increase size. Provide increased box size as required.

D. Junction and pull boxes, condulets, gutters, located above grid ceilings shall be mounted within 18-inches of ceiling grid. Junction and pull boxes above grid ceilings shall be mounted in the same room served. Junction boxes and pull boxes required for areas with inaccessible ceilings shall be located above the nearest accessible ceiling area. All junction box or pull box openings shall be side or bottom accessible. Removal of light

fixtures, mechanical equipment or other devices shall not be required to access boxes. Outlet boxes above ceiling for low voltage terminations shall face towards the floor.

E. Use outlet and switch boxes for junctions on concealed conduit systems except in utility areas where exposed junction or pull boxes can be used.

F. Determine from the drawings and by measurement the location of each outlet. Locate electrical boxes to accommodate millwork, fixtures, marker boards, and other room equipment at no additional cost to the Owner. The outlet locations shall be modified from those shown to accommodate changes in door swing or to clear interferences that arise from construction as well as modifying them to center in rooms. The modifications shall be made with no cost as part of coordination. Check the conditions throughout the job and notify the Architect of discrepancies. Verify modifications before proceeding with installation. Set wall boxes in advance of wall construction, blocked in place and secured. Set all wall boxes flush with the finish and install extension rings as required extending boxes to the finished surfaces of special furring or wall finishes. Provide wall box support legs attached to stud to prevent movement of box in wall.

G. Unless noted or directed otherwise at installation, place outlet boxes as indicated on architectural elevations and as required by local codes.

H. Outlets above counters, mount long axis horizontally. Refer to architectural elevations and coordinate to clear backsplash and millwork.

I. Provide pull boxes, junction boxes, wiring troughs, and cabinets where necessary for installation of electrical systems. Surface mounted boxes below 9 feet and accessible to the public shall not have stamped knockouts.

J. Provide weatherproof boxes for interior and exterior locations exposed to weather or moisture.

K. Provide knockout closures to cap unused knockout holes in boxes.

L. Locate boxes and conduit bodies to ensure access to electrical wiring. Provide minimum 12-inch clearance in front of box or conduit body access.

M. Secure boxes to the substrate where they are mounted, or embed boxes in concrete or masonry.

N. Boxes for any conduit system shall not be secured to the ceiling system, HVAC ductwork or piping system.

O. Provide junction and pull boxes for feeders and branch circuits where shown and where required by NEC, regardless of whether or not boxes are shown.

P. Coordinate locations of boxes in fire rated partitions and slabs to not affect the fire rating of the partition or slab. Notify the Architect in writing where modification or construction is required to maintain the partition or slab fire rating.

Q. Exterior boxes installed within 50-feet of cooling towers or water treatment areas shall be of 304 stainless steel, weatherproof NEMA 4X construction.

R. Identification: Paint the exterior and cover plates of building interior junction boxes and pull boxes located above accessible ceilings or non-finished areas to correspond to the following colors:
   1. Orange: - 480/277 VAC systems.

2. Light Blue: - 240 VAC three phase delta systems.
3. Red – All Emergency circuits, regardless of voltage, and fire alarm system.
4. Light Green - 120/208 VAC 3 phase and 120/240 VAC single-phase systems
5. Yellow – Building Management and Control System – BMCS.
6. White - Security and Surveillance equipment circuits.

S. All box covers shall be labeled with Panel ID and circuit numbers of all circuits available in box using permanent black marker. Boxes containing main feeders are to list where fed from and load (example “MSB to Panel HA”). Information listed is to be legible, markovers are not acceptable. Multi-sectional panel numbers are not to be listed on covers (example “LA2” referring to Panel LA sec. 2 is to be listed as “LA”). Label covers for special applications explaining contents (example “Emerg. Gen. Annunciator controls”, “IDF ground”). Do not attach box covers that have both sides painted or labeled differently. In public areas where boxes are painted same color as room per architect, label inside covers. Boxes that are not used shall be labeled as not used and include panel ID. Example “Not Used Panel LA”. Unused raceways not in sight of panel shall be terminated in a box and labeled not used and include panel identification.

T. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

U. Use flush mounting outlet box in finished areas unless specifically indicated as being used with exposed conduit.

V. Locate flush-mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

W. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches with stud separation. Provide minimum 24 inches with separation in acoustic rated walls.

X. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Provide UL listed materials to support boxes in walls to prevent movement. Ensure box cannot be pushed inside wall.

Y. Use stamped steel bridges to fasten flush mounting outlet box between studs.

Z. Install flush mounting box without damaging vapor barriers, wall insulation or reducing its effectiveness.

AA. Use adjustable steel channel fasteners for hung ceiling outlet box.

BB. Do not fasten boxes to ceiling support wires.

CC. Support systems are to hang vertically straight down. All-thread supports, when used, are not to be installed at an angle or bent.

DD. Use gang box where more than one device is mounted together. Do not use sectional box.

EE. Use gang box with plaster ring for single device outlets.

FF. Support outlets flush with suspended ceilings to the building structure.

GG. Mount boxes to the building structure with supporting facilities independent of the conduits or raceways.

HH. Where multiple feeders are in one pull box, conductors shall be wrapped with 3M No. 7700 Arc and fireproof tape.

II. Provide plaster rings of suitable depth on all outlet boxes. Face of plaster ring shall be within 1/8 inch from finished surface.

JJ. Equip boxes supporting fixtures designed to accept fixture studs with 3/8-inch stud (galvanized malleable iron) inserted through back of box and secured by locknut. Boxes not equipped with outlets shall have level metal covers with rust-resisting screws.

KK. Do not mount junction boxes above inaccessible ceilings or in inaccessible spaces. Do not mount junction boxes above ceilings accessible only by removing light fixture, mechanical equipment or other devices. At inaccessible spaces use junction box furnished with light fixture or light fixture wiring compartment UL listed for through wiring.

LL. No more than 12 conduits containing branch circuits may be installed in any junction or pull box.

MM. All junction boxes shall be protected from building finish painters' over spray and from fire proofing overspray. Remove protective coverings when painting and fire proofing are complete.

NN. Bond equipment grounding conductor to all junction and pull boxes.

OO. Do not mount boxes or conduit bodies on walls directly above electrical panels or switchgear located next to walls.

PP. Do not mount boxes or conduit bodies within 18 inches of outside edges of roof access openings.

QQ. Box extenders or plaster rings shall not be used to increase the Code mandated cable capacity of a box. Provide proper size box.

3.2 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused box openings.

END OF SECTION

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SECTION 26 05 38

ELECTRICAL FLOOR BOXES AND FITTINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide electrical floor box and fitting work as required, scheduled, indicated, and specified.

B. All floor boxes and all poke-throughs for line voltage wiring devices or telecommunication outlets shall be the concealed service type.

1.2 QUALITY ASSURANCE

A. UL Label: Electrical boxes, covers, and fittings shall be UL listed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – Provide products that are Buy American Act Compliance

A. Wiremold.

B. Hubbell.

2.2 CONCEALED SERVICE - FLOOR BOXES

A. Wiremold Evolution RFBA 4/6/10 Series.

B. Floor box shall be electro-galvanized sheet steel with fusion-bonded epoxy suitable for direct contact with concrete on grade.

C. Cover assembly shall die-cast aluminum, finish as selected by Architect.

D. Shall deliver electric power and telecommunications from non-proprietary building standard wiring devices and non-proprietary building standard telecommunications ports installed below the surface of the floor.

E. Shall deliver telecommunications without interference from the electric power delivery.

F. Hinged cover shall accept carpet or tile to match floor covering and be 180 degrees reversible.

G. Shall accept conduit sizes up to 2-inches.

H. When hinged cover is closed and no services in place, device shall have no obstructions above surface of floor.

2.3 CONCEALED SERVICE, FIRE RATED, POKE-THROUGH DEVICE

A. Wiremold Evolution Series - 6AT (3-gang) / 8AT (5-gang) /10AT (8-gang)

B. Shall be UL classified two-hour fire rating. Where floor fire rating is three-hour, provide only the 6AT series with a 3-hour fire rating.

C. Shall be UL listed for use with power and low voltage in a single service fitting and shall protect against ingress of water or foreign materials.

D. Shall deliver electric power and telecommunications from non-proprietary building standard wiring devices and non-proprietary building standard telecommunications ports installed below the surface of the floor.

D. Center data channel for six-inch 6AT poke throughs shall accept a minimum of (22) Category 6a cables, center data channel shall accept a minimum of (5) Category 6a cables.

E. Shall be installed in a single core drilled hole.

F. Shall permit use with “H” cut opening in carpet so carpet can be restored if position is vacated.

G. Shall have interchangeable service fitting accessories including hinged guard and low voltage communication inserts.

H. Service fitting cover shall be aluminum, finish as selected by Architect.

2.4 RECESSED FURNITURE FEED POKE-THROUGH DEVICES

A. Wiremold Evolution 6ATCFF Series.

B. Shall be UL classified for use in up to two-hour fire rated floors.

C. Shall be UL listed for use with power and low voltage in a single service fitting and shall protect against ingress of water or foreign materials.

D. Shall be installed in a single core drilled hole.

E. Die-cast aluminum covers, finish as selected by Architect.

2.5 SERVICE FITTING HEADS

A. Shall be brushed aluminum or stainless steel.

B. Shall deliver electrical power from receptacles as designated on the plans.

C. Shall deliver telephone/data through precut bushed opening.

D. Provide non-proprietary building standard line voltage wiring devices.

E. Shall be furnished standard with conduit nipple for direct screw threading into cover assembly.

PART 3 - EXECUTION

3.1 GENERAL

A. Locate position for floor boxes and runs of conduit as shown on the plans, or as required. Coordinate with the Structural Engineer and Architect for dimensional locations of floor boxes prior to cutting or pouring slab.

B. Select appropriate size of floor boxes, poke-through, or multiple services floor boxes for quantity of wiring devices or cables indicated and as recommended by manufacturer.

3.2 INSTALLATION

A. Position floor boxes and install conduits at locations approved by the Architect.

B. After concrete pour, pull wires and install devices according to manufacturer's recommendations.

C. Activate in accordance with the National Electrical Code.

D. Coordinate with floor covering contractor to complete installation.

E. Core drill openings for poke-through service fitting and installation in accordance with manufacturer's instructions and where approved by the Structural Engineer and Architect.
   1. Minimum spacing of 2-feet on center and not more than one unit per each 65-square feet of floor area in each span as required by Fire Resistance Directory.

END OF SECTION

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SECTION 26 05 40

ELECTRICAL GUTTERS AND WIREWAYS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide electrical gutter work as shown, as specified and as required.

B. Application: The types of electrical gutters required for the project include the following:
1. Electrical wiring gutters.
2. Voice / Data / Video / Communication and signal distribution wireway.

1.2 QUALITY ASSURANCE

A. UL Label: Gutters and wireways shall be UL labeled.

PART 2 - PRODUCTS

2.1 ELECTRICAL GUTTERS AND WIREWAYS

A. General: Provide hinged electrical gutters and wireways in the types and sizes indicated or required, minimum 16 gauge thickness, with rounded edges and smooth surfaces; constructed in compliance with applicable standards; with features required.

B. Size: Provide size indicated. Where size is not indicated, construct in accordance with the NEC and other standards. Gutters shall be of manufacturer’s standard lengths, without field cutting or field extensions.

C. Accessories: Provide gutter and wireway accessories where indicated, constructed of same metal and finish as gutters or wireways.

D. Supports: Provide gutter and wireway supports indicated, conforming to NEC, and as recommended by the manufacturer, and as specified in Section 26 05 33 Conduit Systems.

E. Materials and Finishes: NEMA 1 gutters and wireways shall have gray powder coat finish over galvanized steel. Gutters and wireways installed outside shall be NEMA 3RX minimum. Gutters or wireways installed within 100-feet of cooling towers, at kitchen or food preparation areas, and natatorium, spa or therapy pool areas shall be of 304 stainless steel NEMA 4X construction.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide gutters and wireways only where specified or required. Use of gutters and wireways shall be kept to a minimum.

B. Finishing: Remove burrs and sharp edges of gutters and wireways wherever they could be injurious to conductor insulation or jacket.

C. Installation: Install gutters and wireways where shown or required, in accordance with the manufacturer's written instructions, NEC, NECA "Standard of Installation," and with recognized industry practices to ensure that the gutters and wireways comply with the

specified requirements. Comply with requirements of NEMA and the NEC pertaining to installation of electrical gutters.

D. Grounding: Electrically ground gutters and wireways to ensure continuous electrical conductivity. Provide equipment grounding conductor.

E. Conductors:
   1. Complete gutter and wireway installation before starting the installation of conductors.
   2. Provide sufficient space to permit access for installing, splicing, and maintaining the conductors.

F. A maximum of 12 conduits containing branch circuits shall be allowed to be installed in any gutter or wireway.

END OF SECTION

SECTION 26 05 50

FIRESTOPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide firestop as required, and as specified. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

B. Types: Firestop required for the project includes smokestop.

1.2 QUALITY ASSURANCE

A. UL Label: Firestops shall be UL labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Nelson.

B. 3M (Minnesota Mining Manufacturing).

C. Hilti.

D. Specified Technologies, Inc.

E. Metacaulk.

2.2 MATERIAL AND COMPONENTS

A. General: Except as otherwise indicated, provide firestop manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for installation.

2.3 FIRESTOP

A. Conduits: Provide a soft, permanently flexible sealant for 1-1/2 to 2 hour rated fireproofing for steel conduits (up to 4" diameter).

B. Low Voltage Cables, Fiber Optic Cable and Innerduct: Provide Specified Technologies, Inc. EZ-Path single, double, or triple pathways as required.

PART 3 - EXECUTION

3.1 INSTALLATION OF FIRESTOPS

A. General: Install firestops in accordance with the manufacturer's installation instructions and industry practices to ensure that the firestops comply with requirements. Comply with UL and NFPA standards for the installation of firestops.

END OF SECTION

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SECTION 26 09 44

LIGHTING CONTROLS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Lighting control system and components:
   1. Touch panel controls.
   2. Low and line voltage wall stations.
   3. Power interfaces.
   4. Sensors.

1.2 SUMMARY

A. The lighting control system specified in this section shall provide manual lighting control, sensor-based (both occupancy and daylight control when indicated, specified, or required by AHJ.

B. The system shall be capable of turning lighting and plug loads on/off as well as dimming lights (if lighting load is capable and indicated to be dimmed). Dimmers shall be capable of smooth dimming lights to off.

C. All system devices within a group or controlled area shall be networked together, enabling wired or wireless digital communication between devices within that group.

D. The system architecture shall be stand-alone groups (areas) of devices.

E. The system shall not require any centrally hardwired switching equipment.

F. The system shall be capable of wireless, wired, or hybrid wireless/wired communication architectures. All powered devices shall be wired for power. Battery operation shall not be used unless specifically indicated on the drawings, typically due to existing conditions which prohibit wired power sources.

G. The term “occupancy sensor” shall be interchangeable with the term “vacancy sensor” as the control hardware shall be the same device and be capable of either function.

1.3 SUBMITTALS

A. Specification line-by-line compliance review consisting of a marked-up copy of these specifications with contractor comments. Refer to Submittals specification section for additional instructions.

B. Product Datasheets (general device descriptions, dimensions, electrical specifications, wiring details, nomenclature).

C. Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices).

D. Other Diagrams – as needed for special operation or interaction with other system(s).

E. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up and commissioning.

F. Hardware Operation Manuals.

G. Other operational descriptions as needed.

1.4 PROJECT CLOSEOUT DOCUMENTATION

A. Provide a factory published manual
   1. Warranty.
   2. Technical support contact.
   3. Electronic manual on manufacturer's website for free download.

B. Completed Startup/Commissioning Worksheet with Owner's acceptance and date clearly noted.

1.5 QUALITY ASSURANCE

A. All components and the manufacturing facility where product was manufactured must be RoHS compliant.

B. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degrees Fahrenheit (and Celsius) operation.

C. All applicable products must be UL or ETL Listed or other acceptable national testing organization.

1.6 PROJECT CONDITIONS

A. Only install equipment after the following site conditions are maintained:
   1. Ambient Temperature 14 to 105 degrees F (-10 to 40 degrees C).
   2. Relative Humidity less than 90% non-condensing.

B. Standard electrical enclosures shall be permanently installed.

C. Equipment shall be protected from dust, debris and moisture.

1.7 WARRANTY

A. Five (5) year manufacturer's warranty parts replacement beginning upon completion of Factory Start-up and Commissioning date as noted on the Owner accepted Startup / Commissioning Worksheet.

1.8 MAINTENANCE & SUSTAINABILITY

A. Provide new parts, upgrades, and/or replacements available for a minimum of 5 years available to the end user.

B. Provide free telephone technical support.

C. Spare Parts: Provide minimum of 1 unit up to 5% of each hardware device product used, whichever is greater.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. Acuity Brands Lighting, Inc.
2. Legrand North America, LLC.
3. Cooper Lighting Solutions.
4. Douglas Lighting Controls.
5. Lutron – Athena.
6. Leviton.
7. Crestron.
8. Hubbell.
9. ILC – Intelligent Lighting Controls.

2.2 SYSTEM REQUIREMENTS

A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, UL 924 emergency lighting relays, dimming outputs, manual switch stations, manual dimming stations. Combining one or more of these components into a single device enclosure is be permissible so as to minimize overall device count of system.

B. Lighting control zones shall consist of one or more intelligent lighting control components and fully functional in stand-alone operation.

C. Low voltage devices within a lighting control zone shall be capable of being connected with low voltage cabling in any order.

D. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.

E. Power for devices within a lighting control zone shall come from either resident devices already present for that zone. Standalone power supplies are not acceptable.

F. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements.

G. Individual lighting zones requiring or indicated with intelligent room controllers shall be capable of being segmented into several local channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.

H. Operating modes shall be utilized only in manners consistent with local energy codes. Where daylight controls are indicated or required the photocell functions noted below shall be incorporated.
1. Auto-On / Auto-Off (via occupancy sensors)
a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
c. Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.

2. Manual-On / Auto-Off (also called Semi-Automatic or Vacancy)
    a. Pushing a switch will turn lights on.
    b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
3. Auto On / Predictive Off
    a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
    b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
    c. Pressing the switch will turn the lights off and a short “exit timer” begins. After the timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.
4. Auto ON at 50% or less / Auto Off (Occupancy with dimming)
    a. Operating mode designed specifically IECC compliance using occupancy mode for specific areas.
    b. Zones with occupancy sensors automatically turn lights on to maximum 50-percent (adjustable and programmable to 50-perecent max) when occupant is detected.
    c. Pushing a switch will raise or lower light levels.
    d. Zones with occupancy and/or photocell sensors turn lights off when vacancy or dim accordingly when daylight is detected to maintain desired light level.
    e. Pushing a switch will turn lights off.
5. Manual-On to Auto-On/Auto-Off
    a. Pushing a switch will turn lights on.
    b. After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

A. Occupancy sensors:
1. Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
2. Only passive infrared (PIR) technology, which detects occupant motion, shall be used to initially turn lights on from an off state, thus preventing false on conditions.
3. Dual technology sensors shall be used. Only where ultrasonic or microphonic technology might create a false occupied state, not allowing the lights to automatically turn off shall PIR only be used. Acceptable dual technology includes PIR/Microphonics technology (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants or PIR/Ultrasonic technology.
4. Sensors shall include a minimum of one integrated dry contact switching relay, capable of switching 1 amp at 24 VAC/VDC (resistive only) for BAS/BMCS control.
5. Sensors shall be available in multiple lens options which are customized for specific applications.
6. Embedded luminaire sensors shall be capable of both PIR and Dual Technology occupancy detection. Embedded sensors shall have an optional photocell.
7. Ceiling, fixture, recessed, & corner mounted sensors shall be available.
8. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.

B. Daylight (photocell and/or dimming) sensors:
1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.

2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, luminaire depreciation, or luminaire outages).
4. Combination units that have all features of on/off photocell and dimming sensors may be used
5. Luminaire mounted dimming photocells shall be embedded into luminaire such that only the lens shows on luminaire face.

C. Power (Relay) Packs:
1. Power Packs shall incorporate one Class 1 relay, a 0-10 VDC dimming output, and contribute low voltage power to the rest of the system.
2. Power Packs shall accept 120 or 277 VAC, rated for a minimum 16 Amps for any type of lighting load or motor load rated to 1 HP, provide 0-10 VDC dimming control, be plenum rated, and provide Class 2 power to the system.
3. Every Power Pack parameter shall be available and configurable locally.
4. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
5. When required by local code, Power Pack shall install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
6. Secondary Packs shall be available that provide up to 5 Amps of switching and can line voltage dim 120 VAC incandescent/halogen lighting loads.
7. Secondary Packs shall be available that provide up to 5 Amps of switching and can dim line voltage 120/277 VAC magnetic low voltage transformers.
8. Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
9. Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits and control of 0-10 VDC dimming circuit.
10. Secondary Packs shall be available that control louver/damper motors for skylights.
11. Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
12. Power (Secondary) Packs shall be available that provide up to 20 Amps switching of general purposed receptacle (plug-load) control.

D. Relay & Dimming Room Controller (Panel)
1. Panel shall incorporate up to 3 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.
2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
3. Panel shall provide one 0-10VDC dimming output paired with each relay.
4. Panel shall power itself from an integrated 120/277 VAC supply.
5. Panel shall supply current limited low voltage power to other devices in the same lighting zone.
6. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection.

E. Auxiliary Input / Output (I/O) Devices for enhanced room controls:
   1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½" knockout.
   2. Specific I/O devices shall have a dimming control output that can control 0-10 VDC LED drivers by sinking up to 20 mA of current.
   3. Specific I/O devices shall have an input that reads a 0-10 VDC signal from an external device.
   4. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event (toggle the lighting load) or run a local/remote control profile.
   5. Specific I/O devices shall sense state of low voltage outdoor photocells.
   6. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
   7. Specific I/O devices shall sense momentary and maintained contact closures, and either toggle a connected load after a momentary contact or ramp the load high/low during a maintained contact (stopping when the contact releases).

F. Low Voltage Wall Switches & Dimmers:
   1. Devices shall provide toggle on/off switch control.
   2. Devices color shall match building standard line voltage wiring device color.
   3. Devices with mechanical push-buttons shall provide tactile with LED user feedback.
   4. Devices with mechanical push-buttons shall be made available with custom button labeling.

G. Graphic Wall Station:
   1. Minimum 3.5-inch full color touch screen for selecting up to 16 programmable lighting control preset scenes or acting as up to 16 on/off/dim control switches.
   2. Color shall match building standard for line voltage switching.
   3. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
   4. Device shall enable user supplied .jpg screen saver image to be uploaded.
   5. Surface mount to single-gang recessed switch box.
   6. Micro-USB style connector for local computer connectivity.

H. Scene Controllers:
   1. Two, three, four, or eight buttons for selecting programmable lighting control profiles or acting as on/off switches.
   2. Color shall match building standard for line voltage switching.
   3. Devices shall provide LED user feedback.
   4. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
   5. Device shall have LEDs indicating current selection.

2.4 START-UP & SUPPORT FEATURES

A. To facilitate start-up, all devices daisy-chained together shall automatically be grouped together into a functional lighting control zone.

B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any field programming is performed.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide the quantity of sensors required for complete and proper coverage to completely cover the controlled areas. Contractor shall verify room coverage and ceiling heights with manufacturer and provide the quantity and type of occupancy sensors as required. Rooms shall have one hundred (100) percent coverage of small motion detection to completely cover the controlled areas to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only rooms that are to be provided with sensors. Proper judgment must be exercised in executing the work so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components, architectural components, or Owner installed equipment which may cause obstructions to sensor coverage.

B. Provide ceiling mounted sensors. Wall mounted sensors shall only be used where ceiling mounted sensors are proven by the manufacturer to be impractical, or if specifically indicated on the drawings.

C. For ceilings up to 12-feet AFF, control equipment shall be mounted above an accessible ceiling. Control equipment shall be wall mounted on 24x24-inch fire resistive 0.75-inch thick plywood back board mounted to the wall above the ceiling. Do not paint fire resistive plywood or obliterate the fire resistive labeling. Locate the control equipment directly above the space/area main entry wall switch station, observing good installation practice and shall be consistent throughout the project. Where the ceiling is over 12-feet, the control equipment shall be located in an adjoining ancillary room/area where the ceiling is 12-feet AFF or lower, typically adjacent to the ancillary room/area above ceiling control equipment location, verify exact location with Owner.

D. Control units used for the security or fire systems shall be powered from the emergency power source as indicated on the drawings. Other control units shall be powered from the lighting circuit, which they control.

E. Refer to other specification sections for line voltage wiring device requirements, including momentary on/off toggle switches used with low voltage sensors.

3.2 INSTALLATION

A. Use lighting control wiring with jacket color that matches Owner’s cable color standards.

B. Install the work of this Section in accordance with manufacturer’s printed instructions unless otherwise indicated.

C. The installing electrical contractor shall complete, prior to request of factory start up and site commissioning, complete installation of all devices, their respective loads landed and confirmed operations, switches installed, and confirmed operational.

D. The installing contractor shall, prior to request of factory start up and site commissioning, request an on-site meeting by including the manufacture’s local authorized representative, the Owner and the general contractor, to assist in identification of any open-ended issues, thereby eliminating potential for delays and system commission interruptions.

E. Upon confirmation of progress by local factory representative, the installing electrical contractor shall complete the manufacture’s start up request form(s), including any field changes from the contract documents.

F. The installing electrical contractor shall provide a preliminary as-built drawing prior to commissioning to the manufacturer's representative. Drawing shall include all wire routing, room by room device ID's and locations of all lighting control devices.

G. Install sensors in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.

H. Install sensors and switches only in electrical boxes that are clean, free from excess building materials, debris, and similar matter.

I. Install sensors plumb and aligned in the plane of the wall, or ceiling in where they are installed.

J. Install wall occupancy sensor switches in boxes on the strike side of doors as hung. Where more than one switch is in the same location, install switches in a multi gang box with a single cover plate.

K. Provide a cover plate for every switch. Refer to Architectural drawing, elevations, etc. for exact location of wall switches where indicated on the Architectural plans. Coordinate location of all wall switches with other specialty items and millwork and avoid conflicts. Coordinate with all trades to avoid conflicts during construction. Mounting heights of all switches shall comply with current Accessibility Standards and local codes.

L. Unless indicated otherwise, circuit relays/switchpacks ahead of local control switches. Source –> relay/switchpack –> local toggle switch(s).

M. Coordinate with BMCS/BAS Contractor for interface of BMCS/BAS System and wiring connections.

N. Low voltage cabling installed above ceiling shall be supported every 5 feet at a minimum height of 3 feet above grid/ceiling but no closer than six inches below deck. Support system shall be ceiling wire attached to structure and clipped to ceiling support grid using Caddy drop wire securing clip #EC311. Cabling shall hang plumb to devices.

3.3 SENSOR TESTING AND ADJUSTMENT

A. At the time of installation, the contractor shall test and adjust each sensor for proper detection of motion appropriate to room usage. The contractor shall follow the testing and adjustment procedures as written in the manufacturer's installation instructions for each sensor model. Relocate sensors as needed for proper coverage.

B. Prior to testing and adjusting, verify with Owner/Architect the initial settings for each type of area based on its intended function and use.

C. Verify with Owner all adjustable functions of each type of occupancy sensor prior to installation. Set all adjustable functions of each type of occupancy sensor as directed by Owner. Initial settings unless directed by Owner / Architect (some settings may not apply to all sensors):
   1. Time delay = 10-miniutes.
   2. Zero Time Delay = OFF.
   3. Auto-On = OFF.
   4. Manual-On = ON.
   5. Self-Adjust = OFF.
   6. Disable Self-Adjust = OFF.

7. Energy Saver (Dual Level) = ON.
8. Manual Override = OFF.

D. Bi-level occupancy wall switches shall be initially set with the energy saver feature enabled.

E. Before energizing, check for continuity of circuits, short circuits, and grounding connections. After energizing, check devices to demonstrate proper operation.

F. Operate each wall switch with circuit energized and verify proper operation.

3.4 FACTORY COMMISSIONING

A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.

B. The factory commissioning shall include the following services. Programming of all button stations, configuration and of all occupancy sensors and photocells.

C. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
1. Sensor parameters, time delays, sensitivities, and daylighting set points.
2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.).
3. Load Parameters.

D. The electrical contractor shall provide in writing to the manufacturer, General Contractor, Architect, and the Owner with 21 Owner’s business days’ written notice of the requested system startup and adjustment date.

E. The electrical contractor shall provide at least (1) journeyman electrician familiar with the installation of the system dedicated to assisting the factory start-up technician for the entire duration of the commissioning process.

F. Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the Owner's personnel on the adjustment and maintenance of the system.

G. Re-commissioning – After 90 days from full certificate of occupancy, re-calibrate all sensor time delays and sensitivities to meet the Owner’s Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity.

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SECTION 26 24 13

SWITCHBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work Included: Switchboard work as shown, scheduled, indicated, required, and specified.

1.2 QUALITY ASSURANCE

A. UL Labels: Provide switchboards UL labeled for service entrance and meeting requirements of UL 891.

B. NEMA Compliance: Comply with National Electrical Manufacturers Association (NEMA) Standard PB2, "Dead-Front Distribution Switchboards."

1.3 SUBMITTALS

A. Indicate:
1. Detailed dimensions for equipment foot print, front and side elevations.
2. Conduit entrance locations and requirements and restrictions.
3. Enclosure material, finish, and NEMA classification type.
4. Nameplate legends.
5. Size and number of bus bars.
6. Switchboard instrument details.
7. Electrical characteristics including voltage, ampacity, overcurrent device frame size and trip ratings, withstand ratings, and time current curves of all overcurrent devices and components.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Schneider Electric - Square D.

B. ABB General Electric Co.

C. Siemens.

D. Eaton.

2.2 MATERIALS AND COMPONENTS

A. Except as otherwise indicated, provide switchboard manufacturer's materials and components as indicated and as required for a complete installation.

2.3 DEAD-FRONT DISTRIBUTION SWITCHBOARDS

A. The overcurrent protective device short circuit, coordination and arch flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The

appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.

B. Provide a factory-assembled, dead-front construction, metal enclosed, self supporting, switchboard of voltage, phase, ampacity, and short circuit interrupting rating and bracing shown.
   1. Switchboard shall consist of the required number of front and rear aligned vertical sections bolted together to form one metal enclosed rigid switchboard. The switchboard shall be designed as a free-standing with only front access. Rear and/or side access only where indicated to reduce switchboard depth and where NEC required rear access clearance is available.
   2. Switchboard shall include protective devices and equipment shown with interconnections, instrumentation, and control wiring. Small wiring, necessary fuse blocks, and terminal blocks in the switchboard shall be provided. Groups of control wires leaving the switchboard shall be furnished with terminal blocks with numbering strips.
   3. Factory installed permanent lock-off provision for pad-locking in the off position for all protective devices.

C. Enclosure Construction: The switchboard framework shall be fabricated for floor mounting. The framework shall be formed code gauge steel, welded and bolted together to support cover plates, busing, and component devices.
   1. Each section shall have an open bottom and individually removable top plates for installation and termination of conduit. Top and bottom conduit areas shall be shown and dimensioned on the shop drawings. Front plates used for mounting meters, selector switches, or other front-mounted devices shall be hinged, with wiring installed and laced, and with flexibility at the hinged side. Closure plates shall be screw removable and small enough for easy handling by one technician.
   2. Weatherproof enclosure front door(s) shall be pad-lockable and suitable for the intended environmental conditions. When indicated or specified, rear doors shall also be pad-lockable.

D. Busing: The switchboard busing shall be copper.
   1. The bus bars shall be braced to comply with the integrated equipment rating of the switchboard. The main horizontal bus bars between sections shall be located on the back of the switchboard to permit maximum available conduit entry area. The horizontal main bus bar supports, connections, and joints shall be bolted or welded, as required, so as not to require periodic maintenance. Bolted joint connections shall have at least two bolts per joint per phase. Half lapped bus joint construction is not acceptable.
   2. Buses shall be arranged A-B-C, left-to-right, top-to-bottom, and front-to-rear throughout. A ground bus shall be secured to each vertical section structure and extend the entire length of the switchboard.
   3. The main horizontal bus and incoming line shall be isolated and insulated from outgoing busing and cable connections.
   4. Each group mounted section shall have maximum full height bus. Where space is indicated, space shall be bused to install future switches or future circuit breakers sized as shown or a 600 Amp frame size circuit breaker or switch, whichever is greater.
   5. The main horizontal bus shall be non-tapered, fully rated, extended and drilled for future additions and splice plates.

E. Integrated Equipment Rating: Each switchboard, as a complete unit, shall be given a

single integrated equipment rating by the manufacturer. The integrated equipment short circuit rating shall certify that equipment can withstand the stresses of a fault equal to that shown in RMS symmetrical amperes. Ratings shall have been established by actual tests by the manufacturer on similar equipment construction as the subject switchboard. This test data shall be available and furnished, if requested, with or before the submittal of shop drawings.

F. Indicating Instruments: Switchboard instrumentation shall be digital display, panel mounted, rated for 120V, 60 hertz. The display unit shall be UL listed in accordance with UL 508. The electronic metering device shall have the following features:
1. Voltmeter, phase to phase and phase to ground or neutral.
2. Current, per phase RMS and 3 phase coverage.
3. Demand current per phase.
4. Power factor per phase and 3 phase average.
5. Real power, 3 phase total.
6. Reactive power, 3 phase total.
7. Apparent power, 3 phase total.
8. Frequency.
9. Average demand real power.
10. Adjustable demand interval (5 to 60 minutes).
11. Nonvolatile memory.
12. Password protected set-up and reset.
13. 3 current transformers with primary to match bus size and 5 ampere secondary with metering class accuracy.
14. Full scale readouts with the following accuracy:
    a. Current and voltage measurement +/-0.1%
    b. Power and energy +/-0.2%
    c. Frequency +/-0.5%
    d. Power Factor +/-1.0%
    e. Data update time 0.5 seconds (4 wire)
15. Metering Output.
    a. Pulse output based on kWh, kvarh, or kVAh.
    b. Analog output 4-20mA based on kWh, kvarh, or kVAh.
16. Monitoring:
    a. Harmonic analysis through 63rd with THD and TIF.
    b. Event recorder.
    c. Waveform capture.
    d. Data logger.
    e. Triggered trace memory.
17. Communication:
    a. Front port and dual rear mounted RS485 ports.
    b. BACnet protocol (coordinate with BMCS contractor).
    c. Mini RTU: digital 4 in/4 out.
    d. Analog 1 in/4 out.
    e. Local/remote display of all values.
18. Software:
    a. Windows based software shall be provided to enable setpoint programming.

G. The Main Protective Device(s) shall be individually mounted molded case circuit breaker(s):
1. Adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state true RMS sensing, without fusible elements, 100-percent continuous current rating.
2. Main protective devices with frame rated at 1000 Amps or greater shall have integral ground fault interrupter and provided with a portable test set or test

switch.

3. Circuit breakers with 1,200 Amp frame and above shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
4. Provide shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.

H. Feeder and Branch Protective Devices greater than 1,200 Amps shall be individually mounted:
   1. Molded case circuit breakers:
      a. Adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state trip true RMS sensing, without fusible elements; 100-percent continuous current rating.
      b. Energy Reducing Maintenance System switch with local status indicator (ERMS).
      c. Shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.
   2. Fusible switches:
      a. Each switch shall have an individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
      b. Fused switches 600 Amps and below, equipped for class J fuses.
      c. Fused switches 601 Amps and above shall be equipped with Class R or L rejection type fuse holders. Class RK1 or L of ampere rating and type as indicated on the plans suitable for application of the system.
      d. When required by the latest edition of the NEC or the AHJ, 1,200 Amp switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

I. Feeder and Branch Protective Devices 1,200 Amps and below shall be group mounted:
   1. Molded case circuit breakers:
      a. Greater than 250 Amp: Solid state true RMS sensing with adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
      b. 250 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.
      c. 1,200 Amp frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
   2. Fusible switches:
      a. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.
      b. Individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
      c. 600 Amps and below equipped for Class J fuses.
      d. 601 Amps and above shall be equipped for Class R or L rejection type fuse holders.
      e. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

J. Ground Fault Interrupter (GFI) protection: Where shown or required, ground fault protection shall be achieved with adjustable pickup for ground fault currents, field-adjustable from 200 amperes and instantaneous to 60 cycle time delay. The ground fault protection system shall include necessary current sensors, internal wiring, and relays to coordinate opening the monitored faulted circuits.
   1. Ground fault protection shall be set at minimum setting for both current and time during construction. The switchboard manufacturer shall include in the submittal data for the switchboard, the minimum setting of the devices and the recommended setting for normal building operation.
   2. The ground fault system shall be factory-tested before shipment as specified:
      a. The switchboard manufacturer shall provide a factory ground fault protection system test for circuit testing and verification of tripping characteristics. The manufacturer shall pass predetermined values of current through the sensors and measure the tripping time for each phase and neutral. The measured time-current relationships shall be compared to the trip-characteristic curves. If the ground fault device trips outside the range of values indicated on the curve, the ground fault device shall be replaced or recalibrated.
      b. Relays, electrically operated switches, shunt-trip switches, circuit breakers, and similar items shall have proper voltages applied to their circuits and satisfactory operation demonstrated.
      c. Upon completion of the factory ground fault protection system test, the current and time on each ground fault device shall be set to minimum values.

K. Mimic bus: Indicate busing, connections, and devices in single line form on the front panels of the switchboard using red colored plastic strips, fastened flat against the panel face with screws.

PART 3 - EXECUTION

3.1 INSTALLATION OF SWITCHBOARDS

A. Install switchboards where shown, in accordance with the manufacturer's written instructions, and industry practices to ensure that the switchboards meet the specifications. Provide weatherproof NEMA 3R enclosure housing outdoors, at wet locations, or where indicated on the drawings. Provide NEMA 3RX enclosure housing at corrosive locations of either aluminum or stainless-steel construction suitable for the intended environment when indicated on the drawings.

B. Comply with the requirements of NEMA and NEC, and NECA Standard of Installation, for installation of switchboards.

C. Where switchboard is used or indicated as the utility service building disconnect, provide main bonding jumper and neutral to ground bond connected to the building’s grounding system. Do not bond neutral to ground when there is a neutral to ground bond upstream from the same derived neutral system serving the switchboard.

D. Torque bus connections and tighten mechanical fasteners.

E. Install fuses, of ratings shown, in each switchboard. Provide spare fuse cabinet with three fuses of each size provided. Locate in central plant as directed by Owner.

F. Concrete Pads: Install switchboards on a 4" reinforced concrete housekeeping pad. The housekeeping pad shall extend 3" beyond the housing of the switchboard unless shown

otherwise. Switchboard shall be bolted to the housekeeping pad using 3/8" minimum galvanized bolts and anchors on 30" maximum centers. Furnish the exact position of any block outs, dimensions, and location of the housekeeping pads to prevent delay of the concrete work.

G. Adjustment: Adjust operating mechanisms for free mechanical movement. Adjust circuit breaker time characteristic curves as recommended by the Fault Current and Coordination Analysis or as directed by the Engineer.

H. Indicating Instruments: Provide initial factory start-up and programming with Owner present. Integrate with the Building Management System for monitoring and logging of all system data.

3.2 TESTING

A. Notify Owner’s Commissioning Authority (CxA) prior to performing any tests so that the CxA may witness tests at the CxA’s discretion.

B. Pre-energization checks: Before energizing, check switchboards for continuous of circuits and for short circuits.

C. Switchboard insulation resistance test: Each switchboard bus shall be insulation resistance tested after installation is complete except for line and load side connections. Tests shall be made using Biddle Megger or equivalent test instrument at a voltage of not less than 1000 vDC. Resistance shall be measured from phase-to-phase and from phase-to-ground. Minimum acceptable value for insulation resistance is 2 megohms.

D. Ground Fault Interrupter (GFI) test: After completion of construction and before final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's settings for both current and time by a representative of the manufacturer's engineering service department. After the test, set ground fault to 50 percent of overcurrent device rating or 1,200 Amperes, whichever is lower.

E. Provide thermal infrared scan of switchboard under full load as directed and witnessed by Owner. Correct any deficiencies causing abnormal heating and repeat the scan. Provide digital video documentation with deficiencies corrected for comparison to future test. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout, and make corrections prior to close-out.

F. Submittals: Furnish instruments and personnel required for tests. Submit 4 copies of certified test results to the Architect for review. Test reports shall include switchboard tested, date and time of test, relative humidity, temperature, and weather conditions.

3.3 TRAINING

A. Provide minimum 2 hours of dedicated training provided by a factory authorized representative to Owner’s personnel regarding programming, operating, and use of switchboard components including all indicating instruments and safety features.

END OF SECTION

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PANELBOARDS AND ENCLOSURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Panelboards and enclosures, including cabinet, as shown, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

A. UL Standards: Panelboards and enclosures shall confirm to all applicable UL standards and shall be UL labeled.

1.3 SUBMITTALS

A. Indicate:
1. Detailed dimensions.
2. Enclosure material, finish, and NEMA classification type.
3. Location of main circuit breaker.
4. Mounting and trim.
5. Acceptable incoming conductors' size.
6. Electrical characteristics including voltage, ampacity, overcurrent device frame size and trip ratings, bus material and rating, withstand ratings, lugs, and time current curves of all overcurrent devices and components.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Schneider Electric - Square D.

B. ABB-General Electric Co.

C. Siemens.

D. Eaton.

2.2 MATERIALS AND COMPONENTS

A. General: Panelboards shall be dead-front type equipped with fusible switches or circuit breakers as shown and as required.

B. The overcurrent protective device short circuit, coordination and arch flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.

C. Busing Assembly: Panelboard phase, neutral, and equipment ground busing shall be copper. Bus structure and mains shall have ratings as shown and scheduled. Furnish a bare uninsulated ground bus inside each panelboard enclosure. Two section panelboards shall be connected with copper cable, with an ampacity conforming to the upstream overcurrent device. Neutral bus termination quantity for branch circuit panelboards shall match or exceed the maximum number of single pole circuit breakers the panelboard will accept.

D. Main circuit breakers and feeder / branch circuit breakers:
   1. Less than 125 Amps: Thermal magnetic with factory fixed trip.
   2. 125-600 Amps: Thermal magnetic with adjustable instantaneous trip of 5X – 10X with short time tracking.
   3. 601 Amps and larger: Solid state true RMS sensing with adjustable: current set by rating plug or adjustable dial, I^2t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
   4. Provide permanent lock-off device for all fire alarm system branch circuit breakers, for all smoke control fans and equipment, and where indicated or required for circuit breaker to be used as a remote safety disconnect switch.
   5. General requirements:
      a. Make prepared space provisions for additional breakers or fused switches so that no additional bus or connectors will be required to add circuit breakers or fused switches in the available device mounting space.
      b. Two and three pole breakers shall have internal common trips.
      c. All circuit breakers used as the main or branch mounted back-fed main shall be bolt-on. All circuit breakers used in 600 Amp and smaller panelboards shall be bolt-on breakers. Circuit breakers for distribution panelboards rated 601 amps and larger shall have plug-on or bolt-on circuit breakers.
      d. Branch circuit panelboard shall have interrupting capacity as shown or as required, but in no case less 10k AIC for 120/208/240-Volt systems, and 18k AIC for 277/480-Volt systems.
      e. 15 and 20 Amp circuit breakers for lighting circuits shall be UL listed switch duty (SWD).
      f. Personnel ground fault interrupter (GFI) circuit breakers, where shown, shall be maximum 5 mA ground fault trip and shall include a TEST button.
      g. Equipment ground fault interrupter (EGFI/EGPD) circuit breakers, where shown or required shall be 30mA ground fault trip and shall include TEST button.
      h. Circuit breakers with 1,200 Amp and larger frame shall have Energy Reducing Maintenance Switching with local status indicator (ERMS).

E. Fusible Switches for distribution panelboards: Fusible switches shall be quick-make, quick-break type. Each switch shall be enclosed in a separate steel enclosure. The enclosure shall employ a hinged cover for access to the fuses. Interlock cover with the operating handle to prevent opening the cover when the switch is in the ON position. This interlock shall be constructed so that it can be overridden for testing fuses without interrupting service. The switches shall have padlocking provisions in the OFF position. Switches shall include positive pressure rejection type fuse clips for use with UL Class J fuses and be UL labeled for 200,000 AIC.

F. Spaces: Where space for future breakers or switches is shown, panelboard enclosure shall include removable blank panels or knockouts to allow installation of future breakers or switches, prepared spaces, and panelboard busing shall be complete, including required connectors.

G. Integrated Equipment Rating: Do not apply series ratings. Each panelboard, as a complete unit, shall have a short-circuit rating equal or greater than the available short circuit current. Rating shall have been established by tests on similar panelboards with the circuit breakers or fusible switches installed.

H. GFCI circuit breakers not available in the required panel AIC rating shall be series rated with the upstream over current protection device to provide the panelboard with required AIC rating. Coordinate series rating requirements with manufacturer. Mark the panel per NEC 110. The marking shall be visible and state the following: "CAUTION-ENGINEERED SERIES COMBINATION SYSTEM RATED XXX AMPERS. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED".

I. Panelboard Enclosures:
   1. Provide sheet steel enclosures, minimum 16-gauge nominal thickness, with multiple knockouts, unless shown otherwise. Provide all NEMA 1 panelboard fronts with spring-loaded door pulls, and flush lock and key, panelboard enclosures keyed alike to match the Owner's standard key system; coordinate with Owner.
   2. All NEMA 1 enclosure panelboards shall be hinged "door-in-door" type with interior hinged door with hand operated latch or latches, as required providing access only to circuit breaker or fusible switch operating handles, not to exposed energized parts. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips, or other fasteners, requiring a tool for entry. Hand operated latches are not acceptable. Push inner and outer doors shall open left to right. Manufacturer hardware (OEM), screws, and bolts shall be used to secure dead fronts and covers. Do not used third party hardware. Do not use power tools to secure panel hardware. Provide gray powder coat finish over a rust inhibitor.
   3. Equip with interior circuit directory frame, card, and clear plastic covering for panelboards.
   4. Panelboards located in kitchen preparation or natatorium areas shall have Type 316 stainless steel front, door, and trim with a NEMA 1 rating for the entire enclosure.
   5. Panelboards at exterior locations shall be NEMA 4X Type 316 stainless steel.
   6. Panelboards at hose down areas, cooling towers, in greenhouses, and other corrosive locations shall be NEMA 4X 316 stainless steel.
   7. Enclosure shall be for recessed or surface mounting as shown or as required.
   8. Enclosures shall be fabricated by the same manufacturer as panelboards to be enclosed. Multi-section panelboards shall have same physical dimensions.

PART 3 - EXECUTION

3.1 INSTALLATION OF PANELBOARDS AND ENCLOSURES

A. General: Install panelboards and enclosures, as shown, including electrical connections, in accordance with the manufacturer's written instructions, the requirements of NEC, NECA Standard of Installation, and industry practices. Circuit breakers shall be factory installed except for required field modifications due to actual site conditions.

B. Coordination: Coordinate installation of panelboards and enclosures with conductor and raceways installation work.

C. Anchoring: Anchor enclosures to walls and structural surfaces ensuring that they are permanently and mechanically secured.

D. Directory Card: Provide a typed circuit directory card(s) upon completion of work. Directory card shall be of super heavy-weight index card stock, 110 lb, white. Directory shall include type of load (i.e.: receptacles, lighting, exhaust fan, etc.) and location (i.e.: Room 102, Office, etc.) Room number shall be identified as the actual graphics room number assigned to the space and not the room number identified on the Plans. Circuits with shunt trip shall be identified with the control circuit operating the shunt trip (i.e.: Kitchen Hood No. 2). Shunt trip breakers with common trip circuit shall be grouped in the panelboard (i.e.: circuits 1, 3, 5 and 7).

E. Fuses: Install fuses, of the ratings and class shown.

F. Circuit Arrangement: Branch circuits shall be arranged to provide the best possible phase balance, unless shown otherwise.

G. Panelboards not intended to be used as service entrance (SE) rated or for establishing a separately derived neutral system shall have the factory installed neutral to ground bonding screws and straps removed and disposed of.

H. Recessed or flush mounted panelboards: Terminate spare conduits in junction box 18-inches above accessible ceiling close to panelboard location. Label junction box cover as “not used” and include panel identification.
   1. Provide (3) 1-inch and (3) ¾-inch spare conduits above accessible ceiling to j-box from each panelboard section.
   2. Where recessed panelboard is located above another building floor, also provide (3) 1-inch and (3) ¾-inch conduits to j-box in ceiling space on floor below.

I. Conductors shall be bent neatly opposite the fuse switch or circuit breaker to which they are to be attached. Vertically installed conductors shall be neatly tie-wrapped. Conductors shall be connected in a neat and professional manner. Conductors brought in from the top or bottom of the cabinet shall be bent neatly opposite the fuse or circuit breaker to which they are to be attached. Each conductor shall be run along the full height of the panel and returned to the circuit breaker or fuse location to allow relocation of the conductor to any position along the bus. Panelboard shall be cleaned of all construction debris prior to substantial completion review. Neutral and grounding conductors shall be installed similar to the phase conductors.

J. Circuit breakers and conductors installed for SPD devices shall be located on the same side as the SPD to allow the shortest and straightest run of conductors in respect to the location of the SPD device. Route all conductors to the SPD device with straight as possible run, using longest sweep bends and the shortest conductor length possible. Twist all SPD conductors and secure with tie straps wherever possible.

K. Install copper ground bus for copper ground conductors. Ground conductors size #1 and larger are to be landed to panelboard enclosure with mechanical lugs and not to ground bus.

L. Install panels so that breaker number 1 is the top left breaker.

M. In panels that contain multi-layered neutral bus, install neutrals beginning with the back neutral bus row and work forward. Do not make up neutrals on front neutral bus row unless all other rows are full.

N. Label breaker mounting space with stick-on number labels.

O. Mount the fully aligned panelboard such that the maximum height of the top circuit breaker above the finished floor shall not exceed 78-inches. Mount panelboards as high

as practical and such that the bottom of the cabinets will not be less than 6 inches above the finished floor.

3.2 TESTING

A. Before energizing, energization, check for continuity of circuits and short circuits.

B. Provide thermal infrared scan of panelboards under full load as directed and witnessed by Owner. Correct any deficiencies causing abnormal heating and repeat the scan. Provide digital video documentation with deficiencies corrected for comparison to future test. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout, and make corrections prior to close-out.

END OF SECTION

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SECTION 26 27 73

LINE VOLTAGE WIRING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide wiring device work as shown, scheduled, indicated, and specified. Low voltage and/or digital control switches required for lighting controls and lighting control systems shall be as specified and required for the low voltage and / or digital control lighting system. Refer to drawings or other specification sections for low voltage / digital lighting control systems. Cover plates for lighting control systems shall be as specified in this section unless specifically required otherwise by the low voltage / digital control device bulkhead or form factor.

1.2 QUALITY ASSURANCE

A. UL Label: Wiring devices shall be UL labeled.

B. NEMA Standard WD1 and WD6.

C. Fed. Spec. WC596, W-S-896.

1.3 SUBMITTALS

A. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect/Engineer/Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy of the specification section with the product data.

B. Submit a sample of each style and color of 120-Volt duplex receptacle and each 120/277-Volt switch with related cover plate. Attach plate to wiring device and label back side of plate with job description with permanent black marker.

C. Submit manufacturer's product data sheet for each style of device and plate on the project.

D. Submit drawings of plans, elevation and sections of receptacles and outlets in casework, cabinetwork and built-in place furniture. Coordinate dimensions with millwork shop drawings and related architectural drawing series.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Toggle switches, straight blade and twist lock devices, interior cover plates:
   1. Leviton.
   2. Hubbell.
   3. Pass and Seymour.
   4. Eaton.

B. Dimming
   1. Leviton.
   2. Lutron.

2.2 WIRING DEVICE COLOR

A. Device color shall be gray except 20A, 125V receptacles and toggle wall switches which are directly supplied from an emergency source shall be red, and heavy duty 30 Amp and larger simplex devices which shall be black in color where the building standard color is not available. Provide equivalent hospital grade devices where red is not available in grade specified. Verify with Owner / Architect prior to submitting for approval. Color change kits as required for dimming switches. Low voltage lighting control devices specified elsewhere shall match the line voltage wiring device color specified in this section.

2.3 RECEPTACLES

A. Industrial grade tamper resistant smooth face duplex receptacles, 2 pole, 3 wire grounding, with ground connection and poles internally connected to mounting yoke, with metal mounting straps, locking plug-tail or back and side wired with screw type terminals, NEMA indicated, (X=color designation).
   1. 20A, 125V duplex NEMA #5-20R: Leviton #5362-SGX.
   2. 20A, 125V isolated ground duplex NEMA #5-20R: Leviton #5362-IGX.
   3. 20A, 125V ground fault circuit interruption (GFCI) NEMA #5-20R weather and tamper resistant: Leviton #G5362-WTX.
   4. 20A, 125V weather resistant (WR), tamper resistant: Leviton #TWR20-GY.
   5. 20A, 125V plug load control, split circuit marked for “controlled”, tamper resistant: Leviton #TDR20-S1G.
   6. 15A, with 20A feed-through, NEMA #5-15R, 125V duplex, arc fault (AFCI), tamper resistant: Leviton #AFTR1-HGX.

B. Heavy-Duty Simplex: Single heavy-duty type receptacles, with green hexagonal equipment ground screw, with metal mounting straps, back or side wiring, black molded phenolic compound.
   1. 15-60A, 125-250V, straight blade, NEMA configuration as indicated or as required by Owner.
   2. 15-50A, 125-480V, twist lock, NEMA configuration as indicated or as required by Owner.

C. Hospital grade receptacles, 2 pole, 3 wire grounding, with ground connection and poles internally connected to mounting yoke, with metal mount straps, locking plug-tail or back and side wired with screw type terminals, molded phenolic compound, NEMA configuration indicated.
   1. 20A, 125V grounded duplex NEMA #5-20R: Leviton #8300-X.
   2. 20A, 125V isolated ground duplex NEMA #5-20R: Leviton #8300-LIG (orange).
   3. 20A, 125V ground fault circuit interruption (GFCI) with indicator light: Leviton NEMA 5-20R-8898-HGX.
   4. 20A/125V Tamper Resistant Duplex NEMA 5-20R: Leviton 8300-SGX.

D. USB 2-port charger / tamper-resistant with 125-Volt receptacles:
   1. USB type A/C, 1 type A and 1 type C port, 5.1A 5.0VDC charging. 20A, 125V, NEMA 5-20R: Leviton #T5833-HGX.
   2. USB A, 2 type A ports, 5.1A 5.0VDC charging. 20A, 125V, NEMA 5-20R: Leviton #T5832-HGX.

E. USB 4-port charger:
   1. USB type A+C, 2 type A ports and 2 type C ports. 5.0A 5.0VDC charging. Hubbell #USB4ACX.
   2. USB type A, 4 type A ports. 5.0A 5.0VDC charging. Hubbell #USB4X.

2.4 WALL SWITCHES

A. Toggle: Industrial grade flush toggle switches, with mounting yoke insulated from mechanism, equipped with plaster ears, switch handle, back and side-wired screw terminals.
   1. Single-pole, 120/277V, 20A switch: Leviton #1221-2X.
   2. Double pole 120/277V, 20A switch: Leviton #1222-2X.
   3. Three-way, 120/277V, 20A switch: Leviton #1223-2X.
   4. Four-way, 120/277V, 20A switch: Leviton #1224-2G.
   5. Pilot light single-pole, 120/277V, 20A switch: Leviton #1221-PL.
   6. Momentary, 120/277V, 20A, single-pole double throw, center off: Hubbell only #HBL 1557G.

B. Toggle key operated switch (verify manufacture and key type with Owner prior to construction).
   1. Single-pole, 120/277V, 20A key operated switch: Hubbell HBL #1221GY.
   2. Two-pole, 120/277, 20A key operated, Hubbell HBL #1222GY.
   3. Three-way, 120/277V, 20A key operated switch: Hubbell HBL #1223GY.
   4. Four-way, 120/277V, 20A key operated switch: Hubbell HBL #1224GY.
   5. Momentary, single pole double throw, center off, 20A key switch: Hubbell #HBL1557LG.
   6. Key: Hubbell #HBL 1209. Key switches shall be keyed alike to match the Owner’s standard key system. Coordinate with Owner.

C. Rotary key operated switch (verify manufacturer and keying with Owner prior to construction).
   1. Single-pole, 120/277V, 20A key operated switch: Leviton #1221-KL.
   2. Two-pole, 120/277, 20A key operated, Leviton #1222-2KL..
   3. Three-way, 120/277V, 20A key operated switch: Leviton #1223-3KL.
   4. Four-way, 120/277V, 20A key operated switch: Leviton #1224-4KL.
   5. Key switches shall be all keyed alike to match the Owner’s standard key system. Leviton #WS-35 or as otherwise directed by Owner.

2.5 WALL DIMMERS

A. Wall Box Dimmers: Self-contained, wall box mounted, linear slide square law dimmers with ON/OFF switch. Dimmers shall operate continuously at rated load in an ambient temperature up to 40°C and an input of 100 to 277V. Heat sink fins may be removed only as approved by Owner / Engineer for narrow ganging after applying de-rating.
   1. Single-pole, 120/277V, 1000/2308 Watt incandescent / magnetic low voltage: Leviton #AWSMT-MBW.
   2. Single-pole, 120/277V, 1500/3463 Watt incandescent / magnetic low voltage, 2-gang heat sink: Leviton #AWSMT-MCW.
   3. Single-pole, 120/277V, 1920/4432-Watt LED / fluorescent 0-10V dc, 75 mA current sink: Leviton #AWSMT-7DW.
   4. Three, four- or five-way remote switch: Leviton #AWSRT-00W.
   5. Color change kit as required.

2.6 GFCI – GROUND FAULT CIRCUIT INTERRUPTER, BLANK FACE

A. 20A, 125V, GFCI, switch rated, blank face feed through, Hubbell #GFBF20GYL, gray finish, stainless steel cover plate black laser engraved with device protected, (example: DRINKING FOUNTAIN GFCI).

2.7 INTERIOR WALL COVER PLATES AND FASTENERS

A. Type 302 non-magnetic stainless-steel with satin finish (also required for wall box device cover plates for low voltage and digital lighting controls specified elsewhere).

B. Cover plate laser plate engraving for device identification (other than low voltage lighting controls).
   1. Provide laser cover plate engraving with black filling for all wiring devices indicating panelboard name, circuit, and voltage.
   2. Wiring devices connected to emergency/stand-by generator or inverter shall include the word “EMERGENCY”.
   3. Text orientation shall be upright, readable from left to right when cover plate is installed.
   4. Remotely located lighting switches shall also indicate the room or area and zone controlled by each switch. Coordinate specific wording with Owner/Architect.
   5. Blank face GFCI cover plates shall also intuitively indicate the load or equipment served, device, or area protected downstream (“EDF” for drinking fountains, “RM RECEPTS”, “HOOD RECEPTS”, “VENDING”, “REFRIG”, etc.) For other loads, Owner/Architect shall determine name plate wording.

2.8 EXTERIOR COVER PLATES

A. Thomas & Betts CK Series, cast aluminum standard depth, locking mount, while-in-use, wet location, universal configuration.
   1. Vertical mount receptacle: #CKSUV.
   2. Horizontal mount receptacle: #CKMU.
   3. Two-gang: #2CKU.
   4. 30-60 Amp Devices: #CKLSUV.

2.9 CORD REELS AND DROP CORDS

A. Cord Reels:
   1. Lighted cord reels: Industrial grade, LED hand Lamp only, 125V, 45-foot 16/3 SJEO cord, white finish, LED hand lamp. Hubbell #HBLI45163LED with #HBL340PB pivot base.
   2. 20 Amp (2) duplex receptacle cord reels: Industrial grade, 125V, (2) 20A duplex receptacles, GFCI protection, 45-foot 12/3 SJO cord, white finish, yellow outlet box. Hubbell #HBLI45123GF220 with #HBLI340PB pivot base.
   3. 30 Amp receptacle cord reels: Industrial grade, 125/250V, 30A, 45-foot 10/4 SJO cord, white finish, yellow outlet box. Hubbell #HBLI45104 with #HBLI340PB pivot base. 30 Amp NEMA receptacle termination as required by Owner.
   4. 50 Amp receptacle cord reels: Industrial grade, NEMA 4 wet location, 600V, 55A, 50-foot 6/4 SOOW cord, yellow finish, self-retracting, with NEMA 50-Amp maximum receptacle termination as required by Owner. KH-Industries RTMH4L-WW-K6K.
   5. Recessed enclosure for 20 and 30-Amp cord reels recessed above T-grid drop ceilings: Hubbell #HBLIPRBOX recessed cord reel enclosure, white finish, plenum rated.

B. Drop cord receptacles:
   1. 20A, 125V, 25-feet 600 VAC, 3-conductor 12 AWG SOOW cable, twist lock plug, two 125V, 20A duplex WR GFCI outlets, safety yellow rubber outlet box, mesh strain relief cord grips. KH Industries #PP4DD-520-B12F-520.
   2. 20A, 125/250V, 25-feet 600 VAC, 4-conductor 12AWG SOOW cable, twist lock plug, four 125/250V NEMA L1420P outlets, safety yellow rubber outlet box, mesh strain relief cord grips. KH Industries #PP7DD-520-B12F-L1420.
   3. 30-60 Amp, voltage, NEMA plug/receptacle as required by Owner, SOOW cable, number of conductors and length as required, mesh strain relief cord grips.

2.10 FIRST RESPONDER EMERGENCY REMOTE POWER OFF (FREPO) STATION

A. Knox Company Remote Power Rapid Access 4500 Series Shutdown Station
   1. Recessed mount for public spaces and new construction, surface mount for when mounted to equipment or existing construction.
   2. Single lock keyed for local Fire Department/AHJ, verify configuration and keying with Knox Company.
   3. Red Finish.
   4. Tamper alert for integration with building security system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cover plates for receptacles and toggle switches shall be of the same manufacturer throughout unless otherwise noted.
   1. Key switches and keys shall be as specified and also as approved by Owner.
   2. Submit samples for each specified toggle switch and duplex receptacle color to Architect.

B. Install wiring devices where shown and as required, in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.

C. Install receptacles and switches only in electrical boxes that are clean, free from building materials, debris, and similar matter.

D. Install wiring devices plumb and aligned in the plane of the wall, floor, ceiling or equipment rack.

E. Install switches in boxes on the strike side of doors as hung. Install so the up position will close the circuit or will be the highest level of illumination. Where more than one switch is in the same location, install switches in a multi-gang box with a single cover plate.

F. Provide a cover plate for every wiring device and blank cover plates for unused rough-in-only boxes that matches the building standard. Fasten all plates outdoors with type 302 Allen Head "tamper-proof" screws.

G. Mounting heights of all wiring devices shall comply with local accessibility standards and local codes, except where wiring devices are indicated for special purpose and access is only required by maintenance or service personnel.

H. Refer to Architectural drawing and elevations, etc. for exact location of wiring devices. Coordinate location of all wiring devices with other trades, specialty items, and millwork and resolve all conflicts prior to rough-in. Field coordinate exact mounting location with all trades to avoid and resolve conflicts during construction.

I. Locate receptacles for electric drinking fountains/coolers and bottle fill stations below equipment so that the receptacle is accessible and concealed as much as practical from public view by the equipment open cowling so that the receptacle remain readily accessible. For dual level basin equipment, locate receptacle under the upper basin.

J. Provide convenience outlet receptacle within 25-feet of all new electrically operated mechanical equipment.

K. Where exterior receptacles are intended for continuous use, mount in horizontal position with while in use cover plate. (Exterior electric drinking fountains, ice makers, ice storage bins, landscape lighting low voltage transformers, seasonal decorative lighting, etc.)

L. Install wall box dimmers to achieve full rating specified after de-rating for ganging as recommended by manufacturer.

M. Do not share neutral conductor on load side of dimming switches.

N. Install receptacles with grounding pole down, except in any of the following conditions where the grounding pole shall be installed in the up position: healthcare occupancies, if required by local AHJ, if required by Owner's construction standards or if directed by Owner or Architect. If installed horizontally, install with neutral pole on top.

O. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

P. Provide pigtail to each receptacle and each switch. Neutral and phase conductors shall be installed using side or rear entry lugs only. Do not wrap conductors around screw terminals. Tighten all screws and lugs as recommended by manufacturer.

Q. All receptacles and switches shall have a minimum of two wraps of Scotch 33 or equivalent tape around terminal screws.

R. Provide toggle switch within sight of all trap primers, circulation pumps, 120-Volt motors and motorized equipment to serve as the equipment disconnect switch.

S. Mount cord reels and cord reel recessed enclosures to structure with galvanized steel struts and as recommended by manufacturer. Field verify exact location of cord reels with Owner/Architect. Mounting location shall avoid conflicts with piping, light fixtures and ductwork, etc. when cord reel is extended and retracted. Set ball stop as directed by Owner / Architect. Provide hand lamp only type cord reels in commercial / educational automotive garages with classified (hazardous) locations. Provide local toggle switch at standard switch height for hand lamp only cord reels.

T. Mount drop cord suspension hook or j-box to structure to support the cord's weight and additional normal use pulling tension and as recommended by manufacturer. Use cable grips, either with cord grip hanging hook at open ceilings or with chrome plated escutcheon cover plate mounted to recessed j-box at finished ceilings. Field verify exact location, drop height, and NEMA outlet configuration of drop cords with Owner/Architect. Provide weatherproof receptacle cap or covers if located in wet location. Mounting location shall avoid conflicts with piping, light fixtures and ductwork, etc.

3.2 GROUND FAULT PROTECTION FOR PERSONNEL

A. When GFCI personnel protection receptacles are not commercially available or cannot be installed at a readily accessible location or indicated otherwise on the drawings, GFCI personnel protection shall be provided by a remote blank face GFCI wiring device or by

an up-stream GFCI receptacle that also provides downstream GFCI protection and located in a readily accessible location. When branch circuit breaker device with integral GFCI protection is required or specified, it shall be within the manufacture's recommended distance limitations of the connected receptacle(s) or load(s) for proper GFCI personnel protection at the farthest outlet.

B. GFCI personal protection locations include but are not limited to the following:
   1. For other than dwelling units: All single phase 125-250-Volt (150-Volts to ground or less) receptacles 50-Amperes or less, and all three phase 125-250-Volt (150-Volts to ground or less) receptacles 100-Ampres or less in the locations indicated below.
   2. Dwelling units: All single phase 125-250-Volt receptacles installed in the following locations indicated below.
   3. Provide personnel GFCI protection as indicated above in the following locations and all additional locations as required by the NEC.
      a. Outdoors (with exceptions for not readily accessible receptacles with dedicated branch circuits for snow melting, deicing, pipeline/vessel heat receptacles. Provide these loads with 30mA EGFI circuit breaker protection).
      b. Bathrooms/toilets/restrooms.
      c. Janitors/custodial closets and mop sinks.
      d. Laundry areas.
      e. Parking structures, service garages, garages and accessory buildings.
      f. Basements, crawl spaces (including 120-Volt lighting) .
      g. Within 6-feet of all water sources including sinks, mop-sinks, lavatories, bathtubs, shower stalls, faucets, eye wash stations, emergency shower stations.
      h. Indoor damp and wet locations.
      i. Locker rooms.
      j. Indoor swimming pools and natatoriums areas and adjacent corridor/hall convenience receptacle outlets located within 25-feet of all access doors.
      k. Non-dwelling unit therapeutic tubs/pools/whirlpool areas and adjacent corridor/hall convenience receptacle outlets located within 25-feet of all access doors.
      l. Receptacles serving dwelling unit kitchen counter tops.
      m. Vending machines.
      n. Elevators, dumb waiters, escalators, moving sidewalks: receptacles in pits, hoist ways, well ways or those mounted on the cars of elevators and dumb waiters.
      o. Electric vehicle charging equipment.
      p. All receptacles serving kitchen or food preparation counter tops.
      q. Automotive vacuum machines.
      r. Drinking water fountains/coolers and bottle fill stations.
      s. Corded high-pressure spray washing machines.
      t. Tire inflation machines.
      u. Dish washers.
      v. Receptacles at end of cord reels or drop cords.
      w. Boat houses, boat hoist, and all pier/dock receptacles and lighting (excludes shore power that requires GFPE).
      x. Central plant, mechanical rooms and electrical rooms.
      y. Wood, metal, or other material fabrication or vocational training shops.
      z. Receptacles that serve educational science and science prep room counter tops.

C. Where a GFCI protected receptacle outlet is required or indicated behind vending machine, refrigerators or other equipment, provide remote GFCI blank face in same room

as protected receptacle and at a readily accessible location with standard receptacle outlet behind equipment. Refrigerators shall be GFCI protected only where located within 6-feet of power cord distance from the edge of a sink to the surface of the refrigerator.

D. Unless indicated otherwise, locate blank face GFCI device near light switches at same height as light switches or ganged with the light switch. Provide GFCI protection for all receptacle outlets located below 42-inches in all infant through 2-year old day care and similar areas designated for occupancy by infant through 2-year old day care occupants so the GFCI device can easily be intentionally tripped or tested and reset.

E. Provide branch circuit breaker 30mA (EDP) or 100mA (EPE) equipment protection for utilization equipment as required by the NEC and where indicated on the drawings.

3.3 FIRST RESPONDER REMOTE EMERGENCY POWER OFF (FREPO) STATION

A. Provide Knox Company first responder remote emergency power off (FREPO) stations as indicated and/or where required by local AHJ. Mounting locations shall be as directed by the local AHJ and exact locations coordinated with the Architect. FREPOs shall be circuited only to shunt trip or shut-down control circuiting. FREPOs shall be recessed mounted in public locations and in all new construction when attached to building construction. Provide surface mount FREPOs when mounted to equipment or existing construction.

B. Integrate the FREPOs to shut-down the building non-emergency and non-legally required power sources which include the main electrical utility service disconnect circuit breaker(s), other than non-life safety or non-legally required distribution scale UPS equipment, and non-life safety or non-legally required local power generation equipment.

C. Provide FREPOs for fire pump, life safety, and legally required electrical generation equipment only when required by the AHJ. When required by the AHJ, fire pump, life safety, and legally required power generation and/or stored energy power supply equipment shall each have separate dedicated FREPOs that shut down only their associated power generation/stored energy equipment. FREPOs for emergency, and legally required systems shall have minimal 25-foot physical separation from the building main utility service FREPOs and clearly labeled with the equipment that they will shut down. FREPOs for fire pumps shall have minimal 25-foot physical separation from the any other FREPOs and from the building main utility service disconnect and clearly labeled with the equipment that it will shut down.

D. Integrate the FREPOs tamper switch with the building security or building management control system (BMCS) as directed by Owner.

3.4 TESTING

A. Before energizing, check for continuity of circuits, short circuits, and grounding connections.

B. After energizing, check wiring devices to demonstrate proper operation and receptacles for correct polarization, voltage and phase orientation if intended 3-phase equipment is phase orientation dependent for proper motor rotation or operation.

C. Test each individual GFCI receptacle and all downstream receptacles protected by an upstream GFCI device with simulated ground fault tester, make corrections as necessary.

D. Operate each wall switch with circuit energized and verify proper operation.

END OF SECTION

SECTION 26 43 00

SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Surge Protection Device (SPD) covered under this section includes service entrance type surge protection devices suitable for use as Type 1 or Type 2 Devices per UL1449 5th Edition, applied to the line or load side of the utility feed inside the facility. SPDs shall be connected in parallel with the facility's wiring system. The unit shall be manufactured in the USA by a qualified manufacturer of suppression filter system equipment, which has been engaged in the commercial design and manufacture of such products for a minimum of five years.

B. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified and required to finish and install surge protection devices.

1.2 QUALITY ASSURANCE

A. Reference Standard: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise stated in this document:
   1. UL 1449 Fifth Edition
   2. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
   3. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low-Voltage AC Power Circuits.
   4. IEEE 1100 Emerald Book.
   5. National Fire Protection Association (NFPA 70 (NEC), 75, and 78).
   6. UL 1283 – Electromagnetic Interference Filters

B. When requested for verification, provide copies of the following:
   1. Copies of actual let through voltage data in the form of oscilloscope results for both ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C6245.
   2. Copies of test reports from a recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on both a per mode and per phase basis using the ANSI/IEEE C62.41 impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable.

1.3 SUBMITTALS

A. Submit shop drawings complete with all technical information for specific unit dimensions, let through voltage data, detailed installation instructions, maintenance manual, and wiring configuration.

B. Provide detailed marked-up copy of this specification with line-by-line compliance or exception statements to all provisions of this specification.

C. Copies of Manufacturer’s catalog data, technical information and specifications on equipment.

D. Copies of documentation stating that the Surge Protection Device is listed from a Nationally Recognized Testing Laboratory (NRTL) (UL, ETL, etc.) and are tested and

multi-listed to UL 1449 5th Edition and UL 1283.

F. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.

1.4 WARRANTY

A. The manufacturer shall provide a minimum 20-year warranty for high and very high exposure SPDs. Very high exposure unit warranties shall include exposure to temporary extended over-voltage conditions. Provide a minimum 15-year warranty for all medium exposure SPDs, and a minimum 10-year warranty for all other SPDs for parts from date of substantial completion against failure. Contractor shall assist the Owner with manufacturer warranty registration.

PART 2 – PRODUCTS

2.1 APPROVED MANUFACTURER

A. Low exposure, minimum 10-year parts warranty, minimum 50k Amps per mode, 100k Amps per phase, Type 1 and Type 2.
   1. Recessed mount panelboard extension with brushed stainless-steel front:
      a. ACT Communications:471- ###V-050-SS-F-PB flush series.
      b. ABB Current Technology PX3-050-VVV- #X-SF-X-F- # series.
      c. SSI Surge Suppression, Inc. CSMx12-FMPxSS series.
      d. SST Southern Tier Technologies T45-VVVV-50-AWAJ2-C-RKSS(Stainless Steel front).
   2. Branch panelboard surface mounted:
      a. ACT Communications 455 series.
      b. ABB Current Technology CG3 60 series.
      c. SSI Surge Suppression, Inc. CSMx12 series.
      d. SST Southern Tier Technologies T45-VVVV-50AWAJ2-C.

B. Medium exposure, minimum 15-year parts warranty, minimum 120k Amps per mode, 240k Amps per phase, Type 2.
   1. ACT Communications 471 series.
   2. ABB Current Technology CGP3 125 series.
   3. SSI Surge Suppression, Inc. CSMx24 series.
   4. SST Southern Tier Technologies T45-VVVV-120A series.

C. High exposure, minimum 20-year parts warranty, minimum 200k Amps per mode, 400k Amps per phase, Type 2 SPD.
   1. ACT Communications 471 x200 series.
   2. ABB Current Technology TG3 200 series.
   3. SSI Surge Suppression, Inc. CHLxM series.
   4. SST Southern Tier Technologies T45-VVVV-200A series.

D. Very high exposure at service entrance 1,201 Amps and above: Minimum 20-year parts warranty; minimum 200k Amps per mode; 400k Amps per phase, Type 1 and 2 SPD:
   1. ACT Communications 471 x200 SEL series.
   2. ABB Current Technology SEL3 200 series.

   The service entrance protector shall incorporate a combination of TPMOV and Selenium technology allowing for transient surge and temporary over voltage protection. The unit shall be able to prevent common temporary over voltages and high impedance faults from damaging the MOVs, increasing their longevity and ability to protect the critical load. Limited and Intermediate current TOVs can be caused by a loss of the neutral conductor

in a split phase or three phase power system. The available fault current will be determined by the impedance of the loads connected to the phases opposite the SPD and are typically in the range of 30A to 1000A. Minimum 20-year parts warranty, extended over-voltage protection, minimum 200k Amps per mode, 400k Amps per phase, Type 2 SPD. The Selenium elements must limit voltage to the MOV as a percent of nominal as outlined below:

Overvoltage seen by MOVs as % of Nominal				
	available current			
time	30A	100A	500A	1000A
1 cycle	120%	130%	150%	160%
10 cycles	130%	150%	160%	160%
30 cycles	140%	150%	160%	160%

*To verify damage to the MOVs has been mitigated, the percent overvoltage seen at the MOV must be less than 200% for split-phase applications or 173% for three-phase applications (100% is nominal).

2.2 MANUFACTURED UNITS / ELECTRICAL REQUIREMENTS

A. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449, section 37.7.3. MCOV values claimed based on the component's value or on the 30-minute 115% overvoltage test in UL1449 will not be accepted.

B. Unit shall have not more than 10% deterioration or degradation of the UL1449, Voltage Protection Rating (VPR) due to repeated surges.

C. Protection Modes SVR (6kV, 500A) and UL1449 VPR (6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449: Values Depicted are based on a system Without Disconnect / With Disconnect

System Voltage	Mode	MCOV	C3 Wave	UL 1449 VPR Rating
120/240	L-N	150	650/775	700/800
120/208	L-G	150	650/825	700/900
	N-G	0	500/500	900/1000
	L-L	300	950/1250	900/1200
277/480	L-N	320	1125/1225	900/1200
	L-G	320	1075/1225	1200/1200
	N-G	0	900/900	1200/1500
	L-L	550	1950/2200	1800/1800

D. Electrical Noise Filter- each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric noise shall be as follows using the MIL-STD-220A insertion loss test method.
1. 14 dB from 10 kHz to 1 MHz.

E. Each Unit shall provide the following features:
1. Phase Indicator lights, Form C dry contacts, counter and audible alarm.
2. Field testable while installed.
3. High performance interconnecting cable.
4. The UL 1449 Voltage Protection Rating (VPR) shall be permanently affixed to the SPD unit.

5. The UL 1449 Nominal Discharge Surge Current Rating shall be 20kA
6. The SCCR rating of the SPD shall be 200kAIC without requiring an upstream protection device for safe operation.
7. The unit shall be listed as a Type 2 SPD per UL1449.
8. Power wiring: SPD shall be equipped with mechanical lugs that can accept up to #2 AWG wire on High Exposure units and up to #6 on Medium and Low Exposure units.

2.3 POWER CABLES FOR CONNECTION

A. Power wiring: Conductors between all high and very-high SPDs and switchgear shall be high performance interconnect system “Low Z Cable” cables with Ultra Low impedance characteristics at 10kHz and above.

B. High Performance Low Impedance cable shall be #6 AWG minimum for Very High, High, and Medium Exposure SPDs and #10 AWG minimum for Low Exposure SPDs.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

A. The unit shall be installed as close as practical to the facility's wiring system in accordance with applicable national/local electrical codes and the manufacturer's recommended installation instructions. Connection shall be with high performance, low impedance cables in conduit and shall not be any longer than necessary, avoiding unnecessary bends. Minimum wire size and overcurrent protection device for disconnect shall be provided and as recommended by the manufacturer.

B. Units specified for lighting and appliance panel boards as panelboard extensions (EGPE) shall be mounted directly above or below the first section of the panel board it is protecting. Any other mounting location will not be acceptable and shall be corrected, without exception, at no additional cost to the Owner.

C. Units specified for panelboards, switchboards, or motor control centers shall be mounted directly above or adjacent to the panelboard, switchboard or motor control center using unistrut supports secured to structure as required. Conduit length between power distribution panelboard or switchboard shall be less than two inches. Mounting above equipment is not acceptable.

D. Overcurrent device and conductors for devices shall be the maximum recommended by the manufacturer. Manufacturer’s recommendations shall prevail over the information given in the plans and specifications.

E. Provide recessed mounted panelboard extension type enclosures for devices protecting recessed panelboards. Enclosure front shall match panelboard front material and finish. Provide brushed stainless-steel front at kitchens and food processing areas.

3.2 UNIT SELECTION BASED ON EXPOSURE LEVEL

A. (SPDVH) Provide very-high exposure SPDs with Selenium and TPMOV technology for the following new electrical equipment or where indicated:
1. Service entrance rated 1,201 Amps and above.

B. (SPDH) Provide high exposure SPDs for the following new electrical equipment or where indicated:
1. Service entrance rated 801 – 1,200 Amps.

2. Switchboards located outside.

C. (SPDM): Provide medium exposure SPDs at the following new electrical equipment or where indicated:
1. Service entrance rated 401 - 800 Amps.
2. Panelboards above 600 Amps.
3. Motor control centers.
4. Non-service entrance switchboards.

D. (SPDL): Provide low exposure SPDs at the following new electrical equipment or where indicated:
1. Service entrance rated 400 Amps and below.
2. Panelboards 600 Amps and below.

3.3 TESTING

A. Factory Trained Representative shall provide start-up to include initial verification of proper installation, shortest cable connection, and initiate factory warranty. The technician will be required to do the following as a minimum:
1. Verify the installation follows applicable national / local electrical codes related to SPDs and the manufacturer's Installation, Operation and Maintenance Instructions and recommendations.
2. Verify overcurrent device rating.
2. Verify all wiring connections and installation conforms to manufacturer’s recommendations.
3. Record information for each product installed and include in O&M Manual

B. A copy of the Factory diagnostic test report and written approval of the installation shall be included with the Electrical Operating and Maintenance Manual. The Contractor shall make all adjustments, changes, corrections, etc. as required by the Factory Trained Representative so that the installation follows the manufacturer’s installation and operation instructions without additional charge to the Owner.

END OF SECTION

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SECTION 26 51 13

LIGHTING FIXTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work Included: Lighting fixture work is as shown, scheduled and specified.

B. Applications: The applications of lighting fixtures required for the project include the following:
   1. General lighting.
   2. Emergency lighting.
   3. Outdoor area lighting.

1.2 QUALITY ASSURANCE

A. Provide interior building LED fixtures that comply with the Design Lights Consortium (DLC) standards and are DLC or DLC Premium listed as a Qualifying Product at time of proposal submittal date.

B. UL Standards: Lighting fixtures shall conform to applicable UL standards, and be UL or ETL labeled.

C. Light fixtures shall conform to the requirements of NFPA 101, and 70 (NEC).

1.3 SUBMITTALS

A. Submit product data for light fixtures, and emergency lighting equipment, including generator transfer devices.

B. Specification Compliance Review: Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy with the product data.

C. Submittal data shall include luminaire efficiency parameters.

D. Submittal data for exterior luminaries shall include IESNA BUG ratings, backlight, uplight, and glare ratings of each unique luminaire for the orientation and tile specified. Indicate total absolute lumens per luminaire and absolute lumens emitted above horizontal based by each luminaire for the orientation and tile specified.

1.4 WARRANTY

A. Provide 5-year warranty on all light fixtures, including internal or remote LED drivers, all other electrical internal electrical or electronic components except for emergency battery packs or emergency load control device relays. Refer to other specific component warranty requirements below.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Provide products produced by manufacturers shown or scheduled for each type of lighting fixture. Refer to drawings for additional approved manufacturers.
1. Where alternate fixtures to those specified are provided, notification of alternates are required prior to bid in accordance with Section 26 05 12. Full photometric drawings and a spreadsheet indicating the differences between the specified fixtures and alternate fixtures shall be provided as part of the pre-bid notification. The spreadsheet shall indicate all aspects of the alternate fixture that differ from the specified fixture, including, but not limited to the following:
1. Physical Dimensions.
2. Mounting Type.
3. Fixture Ratings/Listings.
4. Housing Materials/Construction.
5. Lumen Output.
6. Fixture Voltage.
7. Fixture Wattage.
8. Fixture Efficacy.
9. CCT.
10. CRI.
11. Beam Angles/Distribution.
12. Manufacturer Warranty.
13. Emergency Power.
14. Controls Requirements.
3. Emergency Battery Packs with self-testing drivers/inverters: Shall be the same manufacturer as the low voltage lighting controls provided on this project. Where there are no low voltage lighting controls specified or provided, the manufacturer shall be Bodine.
Bodine.
Chloride.
Lithonia.
Dual Lite.
IOTA.
4. Emergency Generator/Inverter Load Control Bypass Relay (ELC); UL924 listed and 0-10Vdc compatible: Shall be the same manufacturer as the low voltage lighting controls provided on this project. Where there are no low voltage lighting controls specified or provided, the manufacturer shall be Bodine.
5. Emergency Generator / Inverter Branch Circuit Transfer Switch, UL 1008 listed and 0-10Vdc compatible:
Bodine GTD20A.

2.2 MATERIALS AND COMPONENTS

A. General: Provide lighting fixtures of the size, type, and rating indicated, with all accessories for a complete aesthetic installation.

B. Fixture Types:
1. General:
a. LED Lay-in edge lit or back flat panel / troffer fixtures: Opaque, edge or back lighted, 4000 Kelvin color temperature. 0-10 Vdc dimmable, L70: 60,000 minimum hours.
b. Safety chains and wire guards at fixtures in mechanical and electrical rooms, and high abuse areas. Provide safety chains only for gymnasium fixtures which shall be inherently vandal proof, no wire guards.

c. Fixtures located outdoors, in interior unconditioned spaces, and in wet locations shall be of aluminum construction.
d. Fixtures with door frames shall be of aluminum construction, white finish where located in kitchens, food prep areas, toilets, restrooms, locker rooms, dressing rooms, showers, and unconditioned spaces.
e. DLC, DLC Premium or Energy Star qualified unless specified otherwise.
f. Outdoor fixtures shall include a discrete / replaceable surge suppression device in addition to the surge suppression incorporated in the LED driver.
g. Operating temperature rating shall be between -40 degrees F and 120 degrees F.
i. Color Rendering Index (CRI): ≥ 80 Indoor; ≥ 65 Outdoor
j. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).

2. Downlight Fixtures: Provide recessed downlight fixtures with trim rings compatible with the ceiling material where fixture is to be installed.
3. LED Exit Signs: Provide red lettering. Exit lighting fixtures shall meet the requirements of Federal, State, and Local Codes. Edge-lit exit signs shall have a silver background so that “EXIT” cannot be read backwards from the opposite side.
   a. Gymnasiums, locker rooms, athletic/PE wing and associated corridors, black box theaters, auditorium stages, cafetoriums and kitchens: Vandal resistant, wet location cast aluminum with polycarbonate protective cover exit signs, Lithonia Extreme Series.
4. Emergency Lighting Units: Lead Calcium batteries with self-diagnostics. Provide full light output at 90 minutes of battery operation. LED lamps.
5. Gymnasium light fixtures, glass or acrylic refractors or lenses, round profile, single point swivel pendant or hook mounting, designed to be vandal proof without the need for wire guards, no wire guards.

C. LED drivers:
1. NEMA 410 compliant for in-rush current.
2. Starting Temperature: -40˚ F [-40˚ C].
3. Input Voltage: 120 to 480 (±10%) V.
4. Power Supplies: Class I or II output.
5. Surge Protection: The system must survive 250 repetitive strikes of “C Low” (C Low: 6kV/1.2 x 50 µs, 10kA/8 x 20 µs) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. “C Low” waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
6. Power Factor (PF): ≥ 0.90.
7. Total Harmonic Distortion (THD): ≤ 20%.
8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

D. Voltage: Equipment for use on 120V systems shall be suitable and guaranteed for voltage range of 100V to 130V. Equipment on 277V systems shall be suitable and guaranteed for voltage range of 225V to 290V. Universal voltage equipment shall be suitable and guaranteed for a voltage range of 100V to 290V.

E. Light fixture housing for exterior use: Provide aluminum or stainless housing. Where stainless steel hardware is used, both male and female fasteners shall be stainless steel.

F. Emergency LED battery self-testing drivers and inverters; 5-year warranty. Basis of Design:
   1. Bodine BSL-ST Series for OEM installation.
   2. Bodine BSL310-SI Series for field installation.
   3. Bodine ELI-S Series for line voltage sine wave inverter field installation.

G. Emergency Battery Packs – Exit Signs: Nickel Cadmium battery with self- diagnostics; Minimum 3-year non-prorated replacement warranty.

H. Emergency Generator / Inverter Load Control Device (ELC):
   1. 16 Amp minimum ballast / driver load.
   2. Compatible with 0-10 Volt dimmer switches.
   3. UL 924.
   4. Minimum 3-year warranty.
   5. Integral or remove test switch.

I. Emergency Generator / Inverter branch circuit transfer switch:
   1. UL 1008.
   2. 20 Amp ballast/driver load.
   3. 0-10Vdc dimming compatible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install lighting fixtures of the types indicated, where shown, and at indicated heights in accordance with the fixture manufacturer's written instructions and industry practices to ensure that the fixtures meet the specifications. Fixtures shall fit the type of ceiling system scheduled.

B. Standards: Comply with NEMA standards, applicable requirements of NEC pertaining to installation of interior lighting fixtures, and with NECA Standard of Installation.

C. Attachment: Fasten fixtures to the indicated structural support members of the building. Provide four separate wire supports for recessed ceiling mounted lighting fixtures, one at each corner of fixture. Check to ensure that solid pendant fixtures are plumb. Provide T-bar locking clips on all four sides for lay-in fixtures.

D. Coordination: Field coordinate and locate lighting fixtures in open ceiling areas including mechanical and electrical rooms so that light is not obstructed by piping, ductwork, etc. Locate light fixtures in front of electrical and mechanical equipment to provide adequate illumination for testing and maintenance. Relocate installed light fixtures as directed by Owner / Architect at no additional cost.

E. Final adjustment of all aimable exterior light fixtures shall be in coordination with, and to the satisfaction of, the Owner’s designated representative. Pre-aim all fixtures prior to scheduled final aiming and adjustment with Architect / Owner. Verify that all rotatable optics are in their proper orientation prior to final aiming.

F. Provide vandal resistant exit signs without wire guards in all physical education and athletic sports areas, including egress corridors adjacent to these areas, black box theaters, auditorium stages, vocational shops, cafetoriums and kitchens.

G. Provide exit sign directional arrows as required. Provide a minimum of two and a maximum of 10% spare exit signs to be installed as directed by Architect.

H. Install in accordance with manufacturers instructions.

I. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminary at indicated height.

J. Locate recessed ceiling luminaires as indicated on the Architectural reflected ceiling plan.

K. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

L. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling Ts to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips.

M. Install recessed luminaires to permit removal from below.

N. Install recessed luminaires using accessories and fire stopping materials to meet regulatory requirements for fire rating.

O. Install wall-mounted luminaires at height as directed by Architect.

P. Install accessories furnished with each luminary.

Q. Connect luminaires to branch circuit outlets using flexible conduit as specified.

R. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaires.

S. Bond products and metal accessories to branch circuit equipment grounding conductor.

T. Provide emergency transfer devices for light fixtures powered by generator or inverter emergency lighting circuits which are used for normal lighting and to be switched with the switched normal lighting circuit in the same room, corridor or area.

U. Provide un-switched, constant-hot circuit to all battery powered emergency lighting equipment and emergency load control devices (ELC). Where normal light fixture circuit is switched or contactor controlled, non-switched battery charging or ELC circuit shall originate from same branch circuit breaker as switched lighting circuit.

V. Provide emergency powered light fixture in front of all electrical switchgear, including but not limited to panelboards, switchboards, motor control centers, low voltage control panels, transfer switches, motor controllers and disconnect switches.

W. Provide emergency battery operated light fixtures at all transfer switch locations and at all central battery emergency lighting inverters.

X. Provide automatic controls for exterior light fixtures. Exterior building mounted light fixtures shall be circuited through lighting contactors. Lighting contactors shall be controlled by the Building Management System. Provide separate lighting contactors for:
   1. Parking Lot Lighting.
   2. Building Mounted Lighting.
   3. Exterior Signage.

Y. Lighting contactors shall not be installed above ceiling and shall be readily accessible, located in same room as panelboard serving load.

Z. Wall mounted light fixtures shall be attached to the studs in the walls. Attachment to gypsum board only is not acceptable. Where wall mounted fixtures attach to junction box only, firmly secure junction box to adjoining studs in wall.

AA. Lighting Fixture Supports:
1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction to the structural slab or to structural members within a partition, or above a suspended ceiling.
2. Shall maintain the fixture positions after cleaning and relamping.
3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.

BB. Hardware for surface mounting fixtures to suspended ceilings:
1. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 1/4 inch secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
2. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture. Pre-positioned 1/4-inch studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 1/4-inch toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.

CC. Lighting Fixture Supports for aluminum canopies:
1. Light fixtures mounted under aluminum canopies shall be UL wet location from above listed without a protective ceiling or cover. Light fixture shall not have conduit penetrations or mounting hole penetrations field made in the top of the fixture. Conduit penetration shall be at the end of the fixture only.

3.2 TESTING

A. General: Upon installation of lighting fixtures, and after building circuits are energized, apply electrical energy to demonstrate proper operations of lighting fixtures, emergency lighting, and controls. When possible, correct malfunctioning units at the site, then retest to demonstrate proper operation; otherwise, remove and replace with new units, and proceed with retesting.

B. Pre-Inspection Tasks: Immediately before final inspection, clean fixtures inside and out, including plastics and glassware, adjust trim to fit adjacent surfaces, replace broken or damaged parts, and lamp and test fixtures for electrical and mechanical operations. Any fixtures, or parts of fixtures that show signs of rust or corrosion at the time of completion, shall be removed, and replaced with protected metal parts.

C. Final aiming and adjustment: Aim and adjust lighting fixtures for their intended purpose as specified or as required. Adjustments may include but not be limited to directional aiming, adjusting selectable lumen output, selectable correlative color temperature (CCT), selectable beam pattern, replacing/installing fixture manufacture’s optional optical lens used for adjusting beam patterns or for softening beam edges, replacing/installing manufacture’s optional theatrical/specialty color lens colors. Re-aim and re-adjust as required to the satisfaction of the Architect / Owner, including nighttime adjustment of exterior lighting in the presence of the Architect / Owner.

END OF SECTION

SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. Clearing and grubbing. B. Identification and protection of vegetation indicated to remain. C. Removal from site of paving, curbs, gutters, fences and miscellaneous structures. D. Removal, or disconnecting and capping, utilities and storm drains. E. Removal, storage and protection of site items designated, specified, or directed to be reinstalled. F. Identification and protection of site improvements indicated to remain.

1.03 RELATED SECTIONS

A. Section 02 41 19 – Selective Structure Demolition. B. Section 31 20 00 – Earth Moving. C. Soils Report – Excavation, Filling and Backfilling for Buildings. D. Section 31 23 20 – Trenching and Backfilling for Utilities.

1.04 SUBMITTALS

A. Clearing procedures and operational sequence for review and acceptance by Engineer.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. B. Regulatory Requirements: Comply with applicable requirements of federal, state, and local laws, regulations, and codes having jurisdiction at project site or applicable requirements of these standards and specifications, whichever is more stringent.

1.06 PROJECT CONDITIONS

A. Coordination: Coordinate this work with the work of other Sections to avoid any delay or interference with other work. B. Traffic: Conduct work to ensure minimum interference with vehicular or pedestrian traffic and to permit unencumbered access to site and adjacent properties. 1. Do not close or obstruct streets, sidewalks or public or private passageways without permission from Engineer or authorities having jurisdiction. 2. If required by Engineer or governing authorities, provide alternate routes around closed or obstructed traffic ways.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide materials, not specifically described but required for proper completion of the work of this Section, as selected by the Contractor subject to the approval of the Engineer.

2.02 SEDIMENT DRAINAGE FABRIC

A. Non-biodegradable, sunlight stabilized, woven polypropylene fabric, type which will retain sediment and reduce water runoff velocity; one of the following by listed manufacturer, or approved equal:

1. "Mirafi 100X Sedimentation Control Fabric" by Mirafi, Inc., Charlotte, NC (800) 438-1855.

2. "Propex 1325 Embankment/Erosion Control Fabric" by Amoco Fabrics Company, Atlanta, GA (404) 955-0935. 3. "Trevira Spunbond Engineering Fabric Style 1115 or 1120" by Hoechst Fibers Industries, New York, NY (212) 869-3850.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Report in writing to Engineer all prevailing conditions that will adversely affect satisfactory execution of work. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected. B. Starting work constitutes acceptance of the existing conditions and this Contractor shall then, at his expense, be responsible for correcting all unsatisfactory and defective work encountered.

3.02 PROTECTION

A. Protect existing utilities indicated or made known. B. Protect bench marks, monuments, and reference points from displacement or damage and, if displaced or damaged, replace at no cost to Owner. C. Protect trees and shrubs, where indicated to remain, so trees and shrubs will not be damaged in any way as part of this Work. 1. Where trees are designated to remain on the site: Construct 2 x 4 wood barricades, minimum 3'-0" high around individual trees and groups of trees. Construct barricades at drip line. 2. Protect tree root systems from damage due to deleterious materials caused by run-off or spillage during mixing, use or discarding of construction materials or drainage from stored materials. Protect root systems from compaction, flooding, erosion or excessive wetting. 3. Engage a qualified tree surgeon to remove branches from trees, if required, to clear for new construction. Where directed by Engineer, extend pruning operations to restore natural shape of entire tree. 4. Where cutting is required, tree surgeon shall cut branches and roots with sharp pruning instruments; do not break or chop. Paint cuts over ½" in size with standard tree paint or compound which is waterproof, antiseptic, elastic and free of kerosene, coal tar, creosote and other substances harmful to plants. 5. Store no construction materials, debris, or excavated material within drip line. Permit no vehicular traffic or parking within drip line. 6. Repair for Damaged Trees: a. Engage a qualified tree surgeon to perform tree repair work. b. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged trees. c. Remove dead trees and damaged trees which are determined by the tree surgeon to be incapable of restoration to normal growth pattern. D. Protection of Persons and Property: 1. Barricade open depressions and holes occurring as part of this Work, and post warning lights on property adjacent to or with public access. 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required. 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by operations under this Section. E. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site. F. Maintain access to the site at all times.

3.03 EROSION AND SEDIMENT CONTROL

A. Plan and execute clearing operations to control erosion and sedimentation.

B. Sediment Barriers: 1. Install prior to commencing grubbing operations. 2. Install as shown on drawings at all locations where water flows from construction areas, including entire perimeter of construction areas where ground slopes outward and at drainage structure inlets. Maintain around drainage structures until establishment of vegetation in grassed and landscaped areas or until construction of surfacing in paved areas. 3. Arrange to create ponding behind barriers; remove accumulated sediments and maintain ponding capacity during construction. 4. Sediments shall be removed from flowing water by filtration. Primary filter media shall consist of anchored sediment drainage fabric and straw bales staked or otherwise held securely in place.

3.04 CLEARING

A. Remove trees, shrubs, stumps, bushes, vines, rubbish, undergrowth, deadwood as well as fences and incidental structures from site except as otherwise designated on the drawings to remain.

3.05 GRUBBING

A. Clean out roots 1" in diameter and larger to a depth of at least 12" below the existing ground surface or subgrade of new graded surface, whichever is lower. Treat roots remaining in the soil with a weed killer approved by the Engineer. B. Backfill and compact holes resulting from stump and root removal operations. Comply with requirements specified in Section 31 23 20 for backfill materials, compaction, and installation methods.

3.06 BELOW GRADE REMOVAL

A. Clean out rubbish and incidental structures below the existing ground surface. B. Backfill and compact holes resulting from below grade removal operations. Comply with requirements specified in the Soils Report for backfill materials, compaction, and installation methods.

3.07 DISPOSAL

A. General: 1. Remove brush, grass, roots, trash, and other material from clearing operations. 2. Dispose of away from the site in a legal manner. 3. Do not store or permit debris to accumulate on the job site. B. Do not burn debris at the site. C. Remove tools, equipment and protection when work is complete and when authorized to do so by local authorities having jurisdiction and Engineer.

3.08 UTILITIES

A. Coordinate with utility companies and agencies as required. Contact local utility companies 48 hours minimum prior to start of demolition work. Confirm verbal notices and written notices. Verify locations of all utilities entering site and their locations on site. B. Where utility cutting, capping, or plugging is required, perform such work in accordance with requirements of the utility company or governmental agency having jurisdiction.

END OF SECTION

SECTION 31 20 00
EARTH MOVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. Removal of topsoil, stockpiling on site for later use. B. Excavation of sub-soil to required grades, contours and levels and compaction of subgrade. C. Placing excavated sub-soil and borrow material in fills to required grades, contours and levels and compaction of each fill lift and subgrade. D. Obtaining and transporting to site borrow material, if required. E. Transporting from site and disposing of waste material, including excess topsoil, if required. F. Finish grading of subgrade. G. Placing, finish grading, and compaction of topsoil.

1.03 RELATED SECTIONS

A. Section 02 41 19 – Selective Structure Demolition. B. Section 31 10 00 – Site Clearing. C. Soils Report – Excavation, Filling And Backfilling For Buildings. D. Section 31 23 20 – Trenching And Backfilling For Utilities. E. Section 31 31 16 – Termite Control. F. Section 32 13 13 – Portland Cement Concrete Paving.

1.04 SUBMITTALS

A. Submit 2 copies of following test reports: 1. Field density, moisture, and gradation test reports of each test made. 2. Laboratory test results for each type of soil encountered.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner. C. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the Soil Engineer. D. Testing Services: By independent commercial testing laboratory employed and paid by Contractor, acceptable to Engineer. E. Moisture-Density Relations of Soils: ANSI/ASTM D 698 (Standard Proctor Method).

1.06 PROJECT CONDITIONS

A. Confine equipment, apparatus, materials, storage and operations of workers to limits provided by law, ordinances, permits, contract documents, and as directed. B. Keep dirt, dust, noise, and other objectionable nuisances arising from grading operations to a minimum.

C. Equipment: Type approved prior to use, with proven capability to perform work in acceptable manner, as recommended by manufacturer for use intended. Perform compaction using tamping rollers, pneumatic tired rollers, three-wheeled power rollers, or other approved type equipment.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

A. Fill and Backfill Materials: 1. Provide soil materials free from organic matter, building debris, frozen material, vegetable matter and other deleterious substances, containing no rocks or lumps over 3" in greatest dimension. 2. Satisfactory Material: Fill material is subject to the approval of the Soil Engineer, and is that material removed from excavations or imported from off-site borrow areas, free from roots and other deleterious matter. 3. Unsatisfactory Material: Man-made fills, refuse, or backfills from previous construction, soils not approved for use by the Soil Engineer and soils with USC classifications OL, MH, CH, OH,ML GC and PT, generally described as follows: a. Peat, mulch and other highly organic swamp soils. b. Organic and inorganic clays of medium to high plasticity. c. Elastic silts. d. Other soils not suitable for the intended construction. 4. Do not permit rocks having a dimension greater than 1" in the upper 12" of fill or embankment. 5. Cohesionless material used for structural backfill: Provide sand free from organic material and other foreign matter, and as approved by the Soil Engineer. 6. Inert fill placed under structures and pavement shall consist of imported fill or native soil stabilized with lime or fly ash. Inert fill shall meet the following requirements: Amount finer than 2” sieve = 100% Amount finer than No. 200 sieve = 12% minimum and if PI≤7, 60% maximum Liquid Limit = 40 maximum Plasticity Index =

17 maximum B. Satisfactory Soil Materials: 1. In fill areas provide materials as required to obtain the grades shown on the Drawings. a. ASTM D 2487 Soil Classification Groups GW, GM, SW, SM, SC, CL; Liquid Limit (LL) less than 40; Plastic Index (PI) between 7 and 20; if granular, minimum of 20% must pass No. 200 sieve.

2.02 WEED KILLER

A. Provide a dry, free-flowing, dust-free chemical compound soluble in water, capable of inhibiting growth of vegetation, and approved for use on this Work by governmental agencies having jurisdiction.

2.03 TOPSOIL

A. For areas not covered by building, drives, parking lots, walks or other hard surfaces, provide topsoil consisting of friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and reasonably free from subsoils, roots, heavy or stiff clay, stones larger than 2" in greatest dimension, noxious weeds, sticks, brush, litter, and other deleterious matter. B. Obtain topsoil from sources within the project limits, or provide imported topsoil obtained from sources outside the project limits, or from both sources.

2.04 GEOTEXTILE FABRIC

A. Filter Fabric: Manufacturer’s standard nonwoven pervious geotextile fabric of polypropylene, nylon or polyester fibers, or a combination. Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D 4759. 1. Grab Tensile Strength (ASTM D 4632): 100 lb. 2. Apparent Opening Size (ASTM D 4751): #100 U.S. Standard sieve.

3. Permeability (ASTM D 4491): 150 gallons per minute per sq. ft.

2.05 GRADED AGGREGATE

A. Graded aggregate shall conform to the requirements of Section 703.01 of the Oklahoma Department of Transportation Standard Specifications for Highway Construction, Latest Edition.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

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

3.02 FINISH ELEVATIONS AND LINES

A. Comply with pertinent provisions of Division 1 Specifications. B. Establish and identify required lines, levels, contours, and datum.

3.03 PROTECTION

A. Utilities: 1. Unless shown to be removed, protect active utility lines shown on the Drawings or otherwise made known to the Contractor prior to excavating. If damaged, repair or replace at no additional cost to the Owner. 2. If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted. 3. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner. 4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure his instructions. 5. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer. B. Maintain bench marks, monuments, and other reference points. Reestablish if disturbed or destroyed, at no additional cost to Owner. C. Protect trees and shrubs, where indicated to remain, so trees and shrubs will not be damaged in any way as part of this Work. 1. Excavation Around Trees to Remain: a. Where excavating is required within drip line of trees, hand excavate to minimize damage to root systems and provide sheeting at excavations if required. Use narrow tine spading forks and comb soil to expose roots. Relocate roots in backfill areas. If large, main lateral roots are encountered, exposed beyond excavation limits, bend and relocate without breaking. if encountered immediately adjacent to location of new construction and relocation is not practical, put roots approximately 3" back from new construction. b. Allow no exposed roots to dry out before permanent backfill is placed; provide temporary earth cover, or pack with peat moss and wrap with burlap. Water and maintain in moist condition and temporarily support and protect from damage until permanently relocated and covered with backfill. c. Prune branches in accordance with standard horticultural practice to balance loss to root system caused by damage or cutting of root system. Engage qualified tree surgeon to prune branches. 2. Grading and Filling Around Trees Near Grading Limits: a. Existing Grades: Maintain existing grading within

drip line of trees, unless otherwise indicated on the drawings. b. Lowering Grades: Where existing grade is above new finish grade shown around trees, carefully hand excavate within drip line to new finish grade. Cut roots exposed by excavation or provide permanent protection as recommended by tree surgeon.

c. Raising Grades, Minor Fill: Where existing grade is 6" or less below elevation of finish grade shown, use a topsoil fill mixture. Place a single layer and do not compact; hand grade to required finish elevations. d. Raising Grades, Moderate Fills: Where existing grade is more than 6" but less than 12" below finish grade elevation, place layer of drainage fill on existing grade prior to placing topsoil. Carefully place against trunk of tree approximately 2" above finish grade elevation and extend not less than 18" from tree trunk on all sides. For balance of area within drip line perimeter, place drainage fill to an elevation of 6" below grade and complete fill with a layer of topsoil to finish grade elevation. Do not compact stone or gravel or topsoil layers, and grade to required elevations. 3. Repair for Damaged Trees: a. Engage a qualified tree surgeon to perform tree repair work. b. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged trees. c. Remove dead trees and damaged trees which are determined by the tree surgeon to be incapable of restoration to normal growth pattern. D. Protection of Persons and Property: 1. Barricade open holes and depressions occurring as part of this Work, and post warning lights on property adjacent to or with public access. 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required. 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by operations under this Section. E. Dewatering: 1. Remove all water, including rain water, encountered during trench and substructure work to an approved location by pumps, drains, and other approved methods. 2. Keep excavations and site construction area free from water. F. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site. G. Maintain access to adjacent areas at all times.

3.04 CONSERVATION OF TOPSOIL

A. After the area has been cleared of vegetation, strip the existing topsoil from areas to be excavated, filled or regraded. Strip to 8" minimum depth, without contamination with subsoils. Keep free of roots, stones and other undesirable materials. Do not strip topsoil when wet. B. Stockpile enough topsoil to provide at least 6" depth of topsoil in areas not covered by building, drives, parking lots, walks or other hard surfaces and to fill planting beds and planters. C. Stockpile in an area clear of new construction and convenient to areas shown to receive topsoil later. If directed, spread in areas prepared to receive topsoil. Do not drive heavy equipment over stockpiled or spread topsoil. Do not stockpile to depth exceeding 4-ft. D. Maintain the stockpile in a manner which will not obstruct the natural flow of drainage. 1. Maintain stockpile free from debris and trash. 2. Keep the topsoil damp to prevent dust and drying out. E. Surplus Topsoil: 1. Dispose of surplus topsoil, away from the site at disposal areas arranged and paid for by the Contractor.

3.05 EXCAVATING

A. Perform excavating of every type of material encountered within the limits of the Work to the lines, grades, and elevations indicated and specified herein. Excavation shall be unclassified, regardless of nature of material encountered. Examine site prior to bidding and include cost of rock excavation encountered. B. Satisfactory Excavated Materials:

1. Transport to, and place in, fill or embankment areas within the limits of the Work. C. Unsatisfactory Excavated Materials: 1. Excavate to a distance below grade as directed by the Soil Engineer, and replace with satisfactory materials. 2. Include excavation of unsatisfactory materials, and replacement by satisfactory materials, as parts of the work of this Section. D. Surplus Materials: 1. Dispose of unsatisfactory excavated materials, and surplus satisfactory excavated materials, on the Owners' property as directed by the Engineer. E. Excavation of Rock: 1. Where rocks, boulders, granite, or similar materials is encountered, and where such material cannot be removed or excavated by conventional earth moving or ripping equipment, take required steps to proceed with the general grading operations of the Work, and remove or excavate such material by means which will neither cause additional cost to the Owner nor endanger buildings or structures whether on or off the site. Remove to following depths: a. Under Walks, Building and Paving: To underside of their respective subgrade, as shown on drawings. b. Under Grass Areas: To 12" below finish grade. c. Under Shrub or Flower Beds: To 24" below finish grade. d. Under Trees: To depth below finish grade as shown on landscape drawings. 2. Do not use explosives. F. Excavate and backfill in a manner and sequence that will provide proper drainage at all times. G. Ditches and Gutters: 1. Cut accurately to the cross sections, grades, and elevations shown. 2. Maintain excavations free from detrimental quantities of leaves, sticks, trash, and other debris until completion of the Work. 3. Dispose of excavated materials as shown on the Drawings or directed by the Soil Engineer; except do not, in any case, deposit materials less than 3'-0" from the edge of a ditch. H. Unauthorized Excavation: 1. Unauthorized excavation consists of

removal of materials beyond indicated subgrade elevations or dimensions without specific instruction from the Engineer or the Soil Engineer. 2. Under footings, foundations, or retaining walls: a. Fill unauthorized excavation by extending the indicated bottom elevation of the footing or base to the excavation bottom, without altering the required top elevation. b. When acceptable to the Soil Engineer, lean concrete fill may be used to bring bottom elevations to proper position. 3. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations, unless otherwise directed by the Soil Engineer. I. Stability of Excavations: 1. Slope sides of excavation to 1:1 or flatter, unless otherwise directed by the Soil Engineer. 2. Shore and brace where sloping is not possible because of space restrictions or stability of the materials being excavated. 3. Maintain sides and slopes of excavations in a safe condition until completion of backfilling. J. Shoring and Bracing: 1. Provide materials for shoring and bracing as may be necessary for safety of personnel, protection of work, and compliance with requirements of governmental agencies having jurisdiction. 2. Maintain shoring and bracing in excavations regardless of the time period excavations will be open. 3. Carry shoring and bracing down as excavation progresses.

3.06 FILLING AND BACKFILLING

A. Backfill excavations as promptly as progress of the Work permits, but not until:

1. Acceptance of construction below finish grade; 2. Inspecting, testing, approving, and recording locations of underground utilities; 3. Concrete formwork is removed; 4. Shoring and bracing are removed, and voids have been backfilled with satisfactory materials; 5. Trash and debris have been removed; and 6. Horizontal bracing is in place on horizontally supported walls. B. Ground Surface Preparation: 1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from the ground surface prior to placement of fills. 2. Scarrify to a depth of 9" and proof roll ground surface prior to placement of fills. Remove soft material, fill resulting excavation with satisfactory material, and compact as required by this specification. 3. Plow, strip, or break up surfaces steeper than one vertical to four horizontal, so that fill material will bond with existing surface. 4. When existing ground surface has a density less than that specified under "compacting" for the particular area, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density. 5. At exposed soils in areas to be paved, scarify to a minimum depth of 8", and recompact at a moisture content that will permit proper compaction as specified for fill. C. Placing and Compacting: 1. Place backfill and fill materials in layers not more than 8" in loose depth. 2. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content. 3. Compact each layer to required percentage of maximum density for the area. 4. Do not place backfill or fill material on surfaces that are muddy, frozen, or containing frost or ice. 5. Place backfill and fill materials evenly adjacent to structures, to required elevations. 6. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structures to approximately the same elevation in each lift. 7. Place a minimum of 1.0 feet of inert material or native soils modified with fly ash or lime under building pad.

3.07 FINISH GRADING

A. General: 1. Uniformly grade the areas within limits of grading under this Section, including adjacent transition areas. 2. Smooth the finished surfaces within specified tolerance. 3. Compact with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points and existing grades. 4. Where a change of slope is indicated on the Drawings, radius of approximately 8'-0", unless adjacent construction will not permit such a transition, or if such a transition defeats positive control of drainage. B. Grading Outside Building Lines: 1. Grade areas adjacent to buildings to achieve drainage away from the structures, and to prevent ponding. 2. Finish the surfaces to be free from irregular surface changes, and: a. Shape the surface of areas scheduled to be under walks to line, grade, and cross-section, with finished surface not more than 0.10 ft above or below the required subgrade elevation. b. Shape the surface of areas scheduled to be under pavement to line, grade, and cross- section, with finished surface not more than 0.05 ft above or below the required subgrade elevation.

3.08 COMPACTING

A. Control soil compaction during construction to provide the minimum percentage of density specified for each area as determined according to ASTM D 698. Limit compaction by hand or hand- operated machines to areas less than 10 feet in width. B. Provide not less than the following percentage of maximum density of soil material compacted at plus or minus 2% of optimum moisture content for the actual density of each layer of soil material in place, and as approved by the Soil Engineer. 1. Structures: a. Compact the top 8" of subgrade and each layer of fill material or backfill material at 95% of maximum density. 2. Walks: a. Compact the top 6" of subgrade and each layer of fill material or backfill material at 95% of maximum density. 3. Pavements: a. Compact the top 8" of subgrade and each layer of fill material or backfill material at

95% of maximum density. b. Refer to plans for additional subgrade requirements. 4. Lawn and Unpaved Areas: a. Compact each layer of fill material or backfill material at 95% of maximum density. b. Compact the upper 12" of filled areas, or natural soils exposed by excavating or topsoil removal, at 90% of maximum density. C. Moisture Control: 1. Where subgrade or layer of soil material must be moisture-conditioned before compacting, uniformly apply water to surface of subgrade or layer of soil material to prevent free water appearing on surface during or subsequent to compacting operations. 2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compacting to the specified density. 3. Soil material that has been removed because it is too wet to permit compacting may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value as determined by moisture-density relation tests approved by the Soil Engineer.

3.09 EROSION AND SEDIMENT CONTROL

A. Provide during construction until permanent pavement, plantings and restoration of natural areas is effective in controlling erosion at site. B. Plan and execute construction by methods to control surface drainage from cut, fill, borrow, and grading areas. 1. Minimize amount of bare soil exposed at one time. 2. Schedule operations so ground surface will be disturbed for shortest possible time before permanent construction is installed. 3. Maintain large areas as flat as practicable to minimize soil transport through surface flow. 4. Where steep slopes or abrupt grade changes occur, install temporary diversion berm or dike at top of slope to direct water flow to a control point to be transported downslope in a slope drain. In all cases, do not allow water to flow uncontrolled down slopes. C. Slope Drains: Construct pipe, fiber mats, rubble, portland cement concrete, asphaltic concrete, plastic sheets, or similar materials approved by Engineer. Install to convey water down slopes, complete with apron at top to direct water into the drain and to anchor it in place and stone or rubble placed at outlets to prevent scouring of soil. D. Ground Cover: Protect all exposed soils sloping 7% or greater until construction of permanent surfaces begins. 1. Use straw or other mulches, stone base, plastic sheets, fiber mats, or other effective erosion treatments approved by Engineer.

E. Sediment Barriers: Maintain sediment barriers installed during clearing operations. Repair as necessary to maintain effectiveness. F. Repair washed and eroded areas; reestablish grades to required density, elevations, profiles, and contours.

3.10 SAMPLING AND TESTING

A. Secure the testing laboratory's inspection and approval of subgrades and fill layers before subsequent construction is permitted thereon. B. Density Tests and Reports: 1. Field in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and in intervals as directed by this specification section and the Engineer. 2. ASTM D 2937, the Drive Cylinder Method shall be used only for soft, fine-grained, cohesive soils. 3. Within 24 hours of conclusion of physical tests, 2 copies of test results, including calibration curves and results of calibration tests, shall be furnished to the Engineer. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. C. Maximum Density and Soil Classification: Tests shall be made for each type material or source of material including borrow material. 1. Determine the optimum moisture and laboratory maximum density values in accordance with ASTM D 698 . 2. Determine the Atterberg Limits and Consistency Indexes. a. Liquid Limit shall be determined in accordance with AASHTO T 89. b. Plastic Limit and Plasticity Index shall be determined in accordance with AASHTO T 90. c. Shrinkage Limit shall be determined in accordance with AASHTO T 92. 3. Determine the gradation in accordance with ASTM C 136, ASTM D 422, or ASTM D 1140. D. Fill and Backfill Material Gradation: 1. One test per 2,000 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C 136, ASTM D 422, or ASTM D 1140. E. Moisture Contents: 1. In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. 2. During unstable weather, tests shall be made as dictated by local conditions and approved by the Engineer. 3. Moisture contents shall be tested in accordance with ASTM D 2216. F. In-Place Density and Moisture Content of Subgrades: 1. One test per 1,200 square yards or fraction thereof under pavements. 2. One test per 600 square yards or fraction thereof under building slabs-on-

grade. G. In-Place Density and Moisture Content of Fills and Backfills: 1. One test per 1,200 square yards or fraction thereof of each lift for fill or backfill in areas other than under building slabs-on-grade compacted by other than hand or hand-operated machines.

2. One test per 600 square yards or fraction thereof of each lift for fill or backfill in areas under building slabs-on-grade compacted by other than hand or hand-operated machines. 3. The density for each lift of fill or backfill materials for trenches, pits, building perimeters or other structures or areas less than 10 feet in width, which are compacted with hand or hand-operated machines shall be tested as follows: One test per each area less than 200 square yards, or one test for each 200 linear feet of long narrow fills under building and paving areas and one test for each 600 linear feet of long narrow fills in other areas. 4. If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows: One check per lift for each 1,000 linear feet of long narrow fills under building and paving areas, one check lift for each 2,000 linear feet of long narrow fills in other areas, and a minimum of 2 checks per lift for other fill and backfill areas. H. If, in the Soil Engineer's opinion based on reports of the testing laboratory, subgrade, or fills which have been placed are below specified density, provide additional compacting and testing under the provisions of the Division 1 Specifications.

3.11 TOPSOILING

A. Location: Apply on areas within project grading limits, except in areas shown covered by buildings, walks and pavings. B. Installation: 1. Use topsoil in relative dry state. Do not place in wet or freezing weather. 2. Fine grade to eliminate rough and low areas and to ensure positive drainage, to smoothness suitable for grass seeding or sprigging. Maintain levels, profiles, and contours of subgrade. 3. Remove stones, roots, grass, weeds, trash, debris, and other foreign material while spreading. 4. Manually spread around trees, plants, buildings and other on-site improvements which might be damaged by grading equipment. 5. Place during dry weather, to following minimum depths to bring grades up to required finished grade elevations: a. For Grass Seeding, Sprigging, or Sodding: 6" depth. b. For Shrub Beds: 24" depth. c. For Flower Beds: 18" depth. d. For Trees: To depth shown on landscape drawings. 6. Compact topsoiled areas to 90% of Standard Proctor Density, unless directed otherwise.

3.12 MAINTENANCE

A. Protection of newly graded areas: 1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds; 2. Repair and reestablish grades in settled, eroded, and rutted areas to the specified tolerances. B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

3.13 CERTIFICATION

A. Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Engineer a written report from the testing laboratory certifying that the compaction requirements have been obtained. State in the report the area of fill or embankment, the compaction density obtained, and the type or classification of fill material placed.

END OF SECTION

SECTION 31 22 16
FINE GRADING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Finish grade sub-grade. B. Pace, level, and compact topsoil.

1.02 RELATED WORK

A. Section 31 00 00 – Earthwork B. Section 32 84 00 – Planting Irrigation C. Section 32 92 23 – Sodding D. Section 32 93 00 – Planting

1.03 SAMPLES

A. Submit sample of imported fill to testing laboratory, in air-tight containers. B. Disregard sample submissions if recent test results are available for type of fill.

1.04 PROTECTION

A. Protect landscaping and other features remaining as final work. B. Protect existing structures, fences, roads, sidewalks, paving, and curbs.

PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil: Reuse from stockpile and provide new topsoil as needed. B. Imported Topsoil: friable loam, typical of cultivated topsoils locally; free of subsoil, roots, grass, excessive amount of weeds, stone, and foreign matter; acidity range (pH) of 6.0 to 7.0; containing a minimum of 2 percent and a maximum of 5 percent organic matter. Topsoil shall not be delivered or used for planting while in a frozen or muddy condition.

PART 3 EXECUTION

3.01 INSPECTION

A. Verifying site conditions and note irregularities affecting work of this Section. B. Beginning work of this Section means acceptance of existing conditions.

3.02 SUBGRADE PREPARATION

A. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, in excess of 1 inch in size. Remove sub-grade contaminated with petroleum products. B. Scarify sub-grade to depth of 6 inches where topsoil is scheduled. Remove debris that is brought to the surface in excess of 1 inch in size. C. Review sub-grade scarification with Owner’s Representative prior to commencing placement of topsoil.

3.03 PLACING TOPSOIL

A. Place topsoil in areas where planting is scheduled and as noted on plans. B. Use topsoil in relatively dry state. Place during dry weather. C. Fine grade topsoil eliminating rough or low areas. Maintain levels, profiles, and contours of subgrade. D. Remove stone, roots, grass, weeds, debris, and foreign material while spreading. E. Manually spread topsoil around trees, plants, and structures, to prevent damage. F. Lightly compact placed topsoil. G. Remove surplus subsoil and topsoil from site.

H. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.04 TOLERANCES

A. Top of topsoil: Plus or minus ½ ich.

3.05 SCHEDULE OF LOCATIONS

A. The following paragraphs identify compacted topsoil thickness for various locations. 1. Lawn Areas: 6 inches 2. Planting Beds (shrubs, groundcover, etc.): 12 inches. Includes all beds at grade. 3. Planters: To within 3 inches of rim or top of wall.

END OF SECTION

SECTION 31 23 20
TRENCHING AND BACKFILLING FOR UTILITIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. Trench, backfill and compact backfill as needed for installation of underground utilities, including, but not necessarily limited to, the following: 1. Sanitary sewerage system. 2. Electrical cables and ducts. 3. Gas System. 4. Water Mains. 5. Storm Drainage System.

1.03 RELATED SECTIONS

A. Section 31 10 00 – Site Clearing. B. Section 31 20 00 – Earth Moving. C. Section 33 41 00 – Storm Utility Drainage Piping. D. Section 33 41 01 – Water Distribution System. E. Section 33 41 02 – Gas Distribution System. F. Section 33 41 03 – Sanitary Sewage System.

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner. C. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the Soil Engineer. D. Testing Services: By independent commercial testing laboratory employed and paid by Contractor, acceptable to Engineer. E. Moisture-Density Relations of Soils: ANSI/ASTM D 698 (Standard Proctor Method).

1.05 PROJECT CONDITIONS

A. Confine equipment, apparatus, materials, storage and operations of workers to limits provided by law, ordinances, permits, contract documents, and as directed. B. Keep dirt, dust, noise, and other objectionable nuisances arising from trenching operations to a minimum. C. Equipment: Type approved prior to use, with proven capability to perform work in acceptable manner, as recommended by manufacturer for use intended. Perform compaction using vibratory plate compactors, small tamping rollers, or other approved type equipment.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

A. Ordinary Backfill Materials: 1. Provide soil materials free from organic matter, building debris, frozen material, vegetable matter, and other deleterious substances. Backfill in the lower portion of the trench and the

upper 12" of the trench shall contain no rocks or lumps over 1" in greatest dimension. Backfill in the remainder of the trench shall contain no rocks or lumps over 3" in greatest dimension 2. Satisfactory Material: Backfill material is subject to the approval of the Soil Engineer, and is that material removed from trenches or imported from off-site borrow areas, free from roots and other deleterious matter. 3. Unsatisfactory Material: Man-made fills, refuse, or backfills from previous construction and soils not approved for use by the Soil Engineer. B. Sand Bedding and Backfill Material: 1. Sand bedding and backfill material shall meet the quality requirements of AASHTO M 6, with a gradation as specified below. 2. Sand bedding and backfill material shall consist of well-graded natural sand having hard, strong, durable particles free from deleterious substances and meeting the following gradation requirements: Sieve Designation Mass Percent Passing 3/8 in. 100 No. 4 95-100 No. 8 45-85 No. 16 5-30 No. 50 0-10 No. 20 0-3 C. Coarse Aggregate Bedding and Backfill Material: 1. Coarse aggregate bedding and backfill material shall meet the quality requirements of AASHTO M 80, Class C; and the grading requirements of AASHTO M 43, Size Number 6. 2. Coarse aggregate bedding and backfill material shall consist of a well-graded crushed stone, crushed gravel, or gravel having hard, strong, durable particles free from deleterious substances and meeting the following gradation requirements: Sieve Designation Mass Percent Passing 1 in. 100 3/4 in. 90-100 1/2 in. 20-55 3/8 in. 0-15 No. 4 0-5 No. 200 0-2 3. Coarse aggregate bedding and backfill material used for fiberglass pipe shall meet the above requirements, except that 100% of the material shall pass the 3/4 in. sieve.

2.02 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

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

3.02 FINISH ELEVATIONS AND LINES

A. Establish and identify required lines and elevations.

3.03 PROTECTION

A. Utilities: 1. Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to trenching. If damaged, repair or replace at no additional cost to the Owner.

2. If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted. 3. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner. 4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure his instructions. 5. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer. B. Maintain bench marks, monuments, and other reference points. Reestablish if disturbed or destroyed, at no additional cost to Owner. C. Protection of Persons and Property: 1. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access. 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required. 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this Section. D. Dewatering: 1. Remove all water, including rain water, encountered during trench and sub-structure work to an approved location by pumps, drains, and other approved methods. 2. Keep trenches and site construction area free from water. E. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site. F. Maintain access to adjacent areas at all times.

3.04 TRENCHING

A. Comply with pertinent provisions of Section 31 20 00, and the provisions of this Section. B. Provide sheeting and shoring necessary for protection of the Work and for the safety of personnel. 1. Prior to backfilling, remove all sheeting. 2. Do not permit sheeting to remain in the trenches except when, in the opinion of the Engineer, field conditions or the type of sheeting or methods of construction such as use of concrete bedding are such as to make removal of sheeting impracticable. In such cases, the Engineer may permit portions of sheeting to be cut off and remain in the trench. C. Open Cut: 1. Excavate to required alignments, widths, and depths by open cut. 2. Excavation Classification: Unclassified, regardless of nature of material encountered. Examine site prior to bidding and include costs for excavation of rock or unsuitable materials which may be encountered. 3. If conditions at the site prevent such open cut, and if approved by the Engineer, pipe jacking may be used. 4. Short sections of a trench may be tunneled if, in the opinion of the Engineer, the conductor can be installed safely and backfill can be compacted properly into such tunnel. 5. Remove wet or otherwise unstable material encountered beyond depths, and backfill voids left by such removals, at no additional cost to the Owner. 6. Remove boulders and other interfering objects, and backfill voids left by such removals, at no additional cost to the Owner. 7. Excavating for Appurtenances: a. Excavate for manholes, septic tanks and similar structures to a distance sufficient to leave at least 12" clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks. b. Overdepth excavation beyond such appurtenances that has not been directed will be considered unauthorized. Fill with sand or coarse aggregate bedding material, or lean

concrete as directed by the Soil Engineer, and at no additional cost to the Owner. D. Excavated Material: 1. Stockpile material suitable for backfilling a sufficient distance from banks to avoid overloading and cave-in. 2. Dispose of unsatisfactory excavated materials, and surplus satisfactory excavated materials, away from the site at disposal areas arranged and paid for by the Contractor. E. Trench to the minimum width necessary for proper installation of the utility, with sides as nearly vertical as possible from the bottom of the trench to at least one foot above the top of the pipe. Accurately grade the bottom to provide uniform bearing for the utility. F. Depressions: 1. Except where rock is

encountered, do not excavate below the depth indicated or specified. 2. Where rock is encountered, excavate rock to a minimum overdepth of 4" below the trench depth indicated or specified. G. Where utility runs traverse public property or are subject to governmental or utility company jurisdiction, provide depth, bedding, cover, and other requirements as set forth by legally constituted authority having jurisdiction, but in no case less than the depth shown in the Contract Documents. H. Where trenching occurs in existing lawns, remove turf in sections and keep damp. Replace turf upon completion of the backfilling. I. Cover: 1. Unless indicated otherwise on the Drawings, provide trench depth to maintain the minimum cover indicated below over the top of the installed item below the finish grade. a. All Areas: Water Lines: 48" Sanitary Sewers: 36" Electrical Cables: 42" Electrical Ducts: 36" Storm Sewer: As indicated as plans. Gas System Piping: 36" 2. Where utilities are under a concrete structure slab or pavement, the minimum depth need only be sufficient to completely encase the conduit or pipe sleeve, and electrical long-radius rigid metal conduit riser, provided it will not interfere with the structural integrity of the slab or pavement. J. Special Requirements for Specific Utilities: 1. Electrical System: Trench banks for cable and duct lines may be sloped or widened to limits approved, provided there is no interference with other utilities. Over-excavating and backfilling with selected materials, if rock is encountered, will not be required except for gradual cushioning toward points of abrupt dropoff of rock.

3.05 BEDDING AND BACKFILLING

A. General: 1. Granular bedding and backfill shall be used for pipes and conduits under pavements, driveways, curbs, gutters, steps, equipment slabs, building slabs on grade, and similar use areas. 2. Ordinary bedding and backfill shall be used for pipes and conduits where granular bedding and backfill is not required. 3. Moisten or aerate material to provide optimum moisture content that will obtain specified compaction. Obtain approval of method to obtain moisture content. Do not place bedding or backfill in trenches that are muddy, frozen or contain frost. 4. Special requirements control if any portion of cover in lower portion of trench is in depth of special compaction and material requirements under pavements. 5. Take special care in bedding and backfilling operations to not damage pipe and pipe coatings.

6. Where excavation extends beyond the limits of normal excavation lines in order to remove boulders, wet or unstable materials, or other interfering objects, backfill the voids remaining after removal of the objects as follows: a. When the void is below the subgrade for the utility bedding, use coarse aggregate bedding material and compact to 95% of Standard Proctor Density. b. When the void is in the side of the utility trench or open cut, use sand or coarse aggregate backfill material compacted to 95% of Standard Proctor Density for voids located in trenches where Granular Bedding and Backfill is required and ordinary backfill material compacted to 90% of Standard Proctor Density for voids located in trenches where Ordinary Bedding is required. 7. Provide uniform bearing for the pipe on prepared bottom of the trench. B. Granular Bedding and Initial Backfill: 1. Bedding for PVC Pipes: a. Circular Pipes: Sand or coarse aggregate bedding material shall be placed on the bottom of the trench prior to the installation of the pipe. The bedding shall have a minimum thickness of one-eighth the outside pipe diameter or four (4) inches, whichever is greater. b. Arch Pipe, Elliptical Pipe, or Other Odd-Shaped Conduits: Sand bedding material shall be placed on the bottom of the trench prior to the installation of the conduit. The bedding shall have a minimum thickness of two (2) inches and a width equal to 0.7 times the horizontal span of the conduit. c. Hand or mechanical tamping shall be used to compact the bedding. The surface of the bedding shall be brought to a uniform grade during compaction. d. Bell holes shall be excavated prior to pipe installation to allow for unobstructed assembly of the joint and to assure that the pipe is fully bedded for its entire length. 2. Haunching: a. Circular Pipes: After the pipe has been installed, sand or coarse aggregate bedding material shall be placed to extend up the sides of the pipe to the horizontal centerline. b. Arch Pipe, Elliptical Pipe, or Other Odd-Shaped Conduits: After the conduit has been installed, sand or coarse aggregate bedding material shall be placed to extend up the sides of the conduit to the point of maximum horizontal span. c. Each lift shall not exceed six (6) inches and shall be compacted by hand. Mechanical tamping may be used except when installing plastic or fiberglass pipe or when use of mechanical tampers is not recommended by the pipe manufacturer. d. Sufficient material shall be worked under the haunch of the pipe to provide adequate support. e. Precautions to prevent movement of the pipe during placing of the material under the pipe haunch shall be taken. 3. Initial Backfill: a. Sand or coarse aggregate backfill material shall be placed from the top of the haunching to six (6) inches above the top of the pipe or conduit. b. Each lift shall not exceed six (6) inches and shall be compacted by hand. c. Initial backfill shall be placed simultaneously on both sides of the pipe to prevent displacement. 4. Each lift of bedding, haunching and initial backfill materials shall be compacted to 95% of Standard Proctor Density. 5. PVC Pressure Pipe: Sand bedding and backfill material shall be used for bedding, haunching, and initial backfill. 6. PVC (solid wall) Sewer Pipe: a. Coarse aggregate bedding material shall be used for bedding and haunching. b. When depth of cover exceeds 12 feet, coarse aggregate bedding material shall extend to the top of the pipe. C. Ordinary Bedding and Initial Backfill: 1. Bedding:

a. Shape trench bottom to conform to the bottom of the pipe or conduit for a width equal to 0.5 times the diameter or horizontal span of the pipe or conduit unless specifically recommended otherwise by the pipe or conduit manufacturer. b. At the Contractor's option, sand or coarse aggregate bedding material may be used for bedding. If used, this bedding shall conform to the requirements for Granular Bedding for Flexible Pipes. The bedding material shall be extended above the bottom of the pipe for one-sixth of the pipe diameter or height. c. Bell holes shall be excavated prior to pipe installation to allow for unobstructed assembly of the joint and to assure that the pipe is fully bedded for its entire length. d. If rock is encountered in the bottom of the trench, trench shall be overexcavated and sand or coarse aggregate bedding material shall be placed in conformance with the requirements for Granular Bedding for Flexible Pipes. The bedding material shall be extended above the bottom of the pipe for one-sixth of the pipe diameter or height. 2. Haunching: a. After the pipe or conduit has been installed, ordinary backfill material shall be placed to extend up the sides of the pipe or conduit to the point of maximum horizontal span. b. Each lift shall not exceed six (6) inches and shall be compacted by hand. c. Sufficient material shall be worked under the haunch of the pipe to provide adequate support. d. Precautions to prevent movement of the pipe during placing of the material under the pipe haunch shall be taken. 3. Initial Backfill: a. Ordinary backfill material shall be placed from the top of the haunching to six (6) inches above the top of the pipe or conduit. b. Each lift shall not exceed six (6) inches and shall be compacted by hand. c. Initial backfill shall be placed simultaneously on both sides of the pipe to prevent displacement. 4. At the Contractor's option, sand or coarse aggregate bedding and backfill material may be used for haunching and initial backfill. 5. Each lift of bedding, haunching, and initial backfill materials shall be compacted to 90% of Standard Proctor Density. 6 PVC Pressure Pipe: Bedding, haunching and initial backfill shall conform to the requirements for Granular Bedding and Backfill for Flexible Pipes, except that sand bedding and backfill material shall be used. 7. PVC (solid wall) Sewer Pipe: Bedding and haunching shall conform to the requirements for Granular Bedding and Backfill for Flexible Pipes, except as follows: a. Coarse aggregate bedding material shall be used. b. When depth of cover exceeds 12 feet, coarse aggregate bedding material shall extend to the top of the pipe. D. Final Backfill: 1. Do not completely backfill trenches until required pressure and leakage tests have been performed, and until the utilities systems as installed conform to the requirements specified in the pertinent Sections of these Specifications. 2. Reopen trenches which have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of the Soil Engineer. 3. Do not allow or cause any of the Work performed or installed to be covered up or enclosed by work of this Section prior to required inspections, tests, and approvals. 4. Should any of the Work be so enclosed or covered up before it has been approved, uncover all such Work and, after approvals have been made, refill and compact as specified, all at no additional cost to the Owner. 5. Rolling equipment shall not be used until a minimum of two feet of backfill material has been placed over the top of the pipe. If a hydro hammer is used to compact the backfill, a minimum of three feet of cover is required. 6. Granular Backfill:

a. Trenches shall be backfilled with sand or coarse aggregate backfill material and brought to the subgrade elevation required for surface or base course construction. b. Backfill shall be placed in successive horizontal layers not exceeding 8 inches in loose depth for the full width of the trench and compacted. c. Each lift of final backfill shall be compacted to 95% of Standard Proctor Density. d. Backfill up to elevation at which requirements for pavement subgrade material and compaction take effect. 7. Ordinary Backfill: a. Trenches shall be backfilled with ordinary backfill material and brought to the subgrade elevation required for surface construction or topsoiling. b. Backfill shall be placed in successive horizontal layers of 8 inches to 12 inches in loose depth for the full width of the trench and compacted. c. Each lift of final backfill shall be compacted to 90% of Standard Proctor Density. d. Provide approved additional backfill material if acceptable material is not available from excavation. e. At the Contractor's option, sand or coarse aggregate backfill material may be used for final backfill, except for the upper 24 inches. E. Backfill Around Structures and Appurtenances: 1. Backfill around manholes, inlets, fire hydrants, valves, cleanouts, and similar appurtenances shall conform to trench backfill requirements, except as modified on the Drawings. 2. Take care to prevent wedging action of backfill against appurtenances by carrying the material uniformly around the appurtenances to approximately the same elevation in each lift. F. Consolidation of backfill by jetting with water may be permitted, when specifically approved by the Soil Engineer, in areas other than building and pavement areas.

3.06 TEST FOR DISPLACEMENT OF SEWERS AND STORM DRAINS

A. Check sewers and storm drains to determine whether displacement has occurred after the trench has been backfilled to above the pipe and has been compacted as specified. B. Flash a light between manholes or, if the manholes have not yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a

mirror. C. If the illuminated interior of the pipe line shows poor alignment, displaced pipes, or any other defects, correct the defects to the specified conditions and at no additional cost to the Owner.

3.07 PIPE JACKING

A. The Contractor may, at his option, install steel pipe casings, tongue-and-groove reinforced concrete pipes, and steel pipes under existing roads or pavements by jacking into place using procedures approved by the governmental agencies having jurisdiction and approved by the Soil Engineer.

3.08 TUNNELING OPERATIONS

A. The Contractor may, at his option, tunnel pipes into position using procedures approved by the Soil Engineer and the governmental agencies having jurisdiction.

3.09 SAMPLING AND TESTING

A. Secure the testing laboratory's inspection and approval of subgrades and fill layers before subsequent construction is permitted thereon. B. Density Tests and Reports: 1. Field in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017, the calibration checks of both the density and moisture gauges shall be made at the beginning of

a job on each different type of material encountered and in intervals as directed by the Engineer. 2. ASTM D 2937, the Drive Cylinder Method shall be used only for soft, fine-grained, cohesive soils. 3. Within 24 hours of conclusion of physical tests, 2 copies of test results, including calibration curves and results of calibration tests, shall be furnished to the Engineer. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. C. Maximum Density and Soil Classification: Tests shall be made for each type material or source of material including borrow material. 1. Determine the optimum moisture and laboratory maximum density values in accordance with ASTM D 698. 2. Determine the Atterberg Limits and Consistency Indexes. a. Liquid Limit shall be determined in accordance with AASHTO T 89. b. Plastic Limit and Plasticity Index shall be determined in accordance with AASHTO T 90. c. Shrinkage Limit shall be determined in accordance with AASHTO T 92. 3. Determine the gradation in accordance with ASTM C 136, ASTM D 422, or ASTM D 1140. D. In-Place Density and Moisture Content of Backfills: 1. The density for each lift of backfill materials for trenches shall be tested as follows: One test for each 300 linear feet of trench under building and paving areas and one test for each 600 linear feet of trench in other areas. 2. If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows: One check per lift for each 1,500 linear feet of trench under building and paving areas and one check per lift for each 3,000 linear feet of trench in other areas. E. If, in the Soil Engineer's opinion based on reports of the testing laboratory, backfills which have been placed are below specified density, provide additional compacting and testing under the provisions of Section 01 40 00 of these Specifications.

3.10 CERTIFICATION

A. Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Engineer a written report from the testing laboratory certifying that the compaction requirements have been obtained. State in the report the area of trench backfill, the compaction density obtained, and the type or classification of backfill material placed.

END OF SECTION

SECTION 31 25 00
EROSION CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 DESCRIPTION

A. The work under this section consists of providing all work, materials, labor, equipment, and supervision necessary to provide and construct erosion control measures necessary to protect property and the environment. Included are the following topics: B. Provide erosion & stormwater control in accordance with the following references: 1. applicable State Environmental Agency Stormwater General Permit for Construction Activities, Latest revision or amendment; C. Or for projects on Federal/Indian Trust Lands, 1. U.S. EPA Construction General Permit http://cfpub.epa.gov/npdes/stormwater/cgp.cfm , Latest revision or amendment;

1.03 SUBMITTALS & DOCUMENTATION

A. The Contractor will submit or provide the following to the Owner: 1. Construction Site Erosion Control Plan, if required. Contractor shall mark-up or create additional versions of the Erosion Control Plan that is included in these documents showing additional or alternate erosion control measures as needed due to the Contractors means and methods throughout all phases of construction. 2. Submittals for materials used to implement the erosion control plan.

1.04 EROSION CONTROL PLAN/SWP3

A. For project disturbing one acre of land or more: 1. The contractor shall provide a Stormwater Pollution Prevention Plan (SWP3) in accordance with applicable State Environmental Agency and/or Environmental Protection Agency stormwater requirements. The contractor shall complete and submit any required documents, including but not limited to the Notice of Intent(NOI), Notice of Termination(NOT) to applicable agency having jurisdiction. 2. Contractor shall be responsible for insuring the completion of the SWP3 and compliance with the applicable General Permit. 3. Contractor shall comply with all the requirements of the erosion control plan, and the requirements of the General Permit to Discharge. Erosion control and storm water management practices shall be installed and maintained in accordance with the erosion control plan and General Permits. 4. Contractor shall provide all erosion control practices necessary to protect property and the environment. Erosion control and storm water management practices shall be installed and maintained in accordance with the erosion control plan and the applicable General Permit. The contractor shall update and modify the erosion control plan as needed for phasing of work. A copy of the current erosion control plan shall be maintained at the project site.

PART 2 - MATERIALS

2.01 GENERAL

A. When the design or contract includes permanent erosion control or stormwater control features, the contractor may employ these items to control erosion and stormwater during construction activities. However, these features shall be fully cleaned and restored to the original design providing full function for the intended permanent use prior to acceptance of the work.

2.02 SILT SCREEN FENCE

A. Fabric shall be a woven polypropylene geotextile fabric B. Silt screen fences shall be installed at least 6 feet from the right-of-way or property line, unless otherwise noted. Framework supports shall have a maximum spacing of 10 feet center to center, or as shown on the construction plans. Filter material shall be secured to the ground between supports to prevent the material from curling or rolling up. Silt screen fences may be removed or left in place as determined by the Engineer. C. Silt screen fences shall be kept free from debris and sediment build up. Sediment removal shall be removed at the direction of the Engineer. Material removed shall be disposed of in a manner and location approved by the Engineer. After the sediment removal has been completed, the control devices shall be left in operable condition. Any damage to the control devices shall be replaced at the Contractor’s expense.

2.03 EROSION MAT

A. Erosion mat shall consist of a machine produced wood excelsior mat with interlocking fibers that form a continuous web. Cover the mesh on one side with an extruded plastic netting with mesh size no greater than 1” x 2”.

2.04 STAPLES

A. Permanent installations: Use biodegradable staples in accordance with manufacturer’s recommendations for materials being anchored. Wood and metal staples are not allowed for permanent installations.

2.05 SOIL STABILIZERS

A. Soil stabilizers shall be non-asphalt-based products of the type approved by Owner.

PART 3 - EXECUTION

3.01 GENERAL

A. Install and maintain erosion control measures as required by the erosion control plan throughout phases of the project. Notify Construction Representative of modifications to the erosion control plan as dictated by Contractor’s means and methods, construction phasing or by differing site conditions. B. Contractor shall provide all erosion control measures necessary to prevent and manage polluted runoff from the construction site and discharge of sediment onto adjacent property, into storm sewers or waters of the state. C. Perform all work in accordance with manufacturer's instruction where these specifications do not specify a higher requirement.

3.02 GRADING AND EARTHWORK

A. Install temporary or permanent erosion control measures applicable to each phase of grading or land disturbance prior commencing on that phase. B. Clear only those areas designated for the placement of improvements or earthwork before placement of the final cover. Perform stripping of vegetation, grading, excavation, or other land disturbing activities in phases to minimizing exposure of bare soil. Do not clear the site of topsoil, trees, and other natural ground covers before the commencement of construction. Retain natural vegetation and protect until the final ground cover is placed. C. Do not stockpile soil within 25 feet of any roadway, parking lot, paved area, or drainage structure or channel. Provide temporary stabilization and erosion control measures on disturbed areas and soil stockpiles which will remain for a period of more than 7 consecutive calendar days. D. Remove surplus excavation materials from the site immediately after rough grading. The disposal site for the surplus excavation materials shall also be subject to these erosion control requirements.

3.03 DRAINAGE

A. Divert roof drainage and runoff from all undisturbed areas upslope of the site around disturbed Page 2 of 3 31 25 00

areas. Minimize runoff on exposed soil. Provide measures to remove sediment, and debris. B. Convey clean or treated runoff to the nearest adequate stormwater facility. Do not discharge water in a manner that will cause erosion or sedimentation of the site or receiving stormwater facility. C. Protect storm sewer inlets and catch basins with inlet protection devices. D. Provide ditch checks or silt dikes in swales or ditches to reduce the velocity of water in the channel. E. Dewatering discharge shall be routed to a sedimentation basin or sedimentation vessel to reduce the discharge of sediments. Do not discharge water in a manner that will cause erosion or sedimentation of the site or receiving stormwater facility.

3.04 TRACKING CONTROL

A. Construct and maintain Tracking Pads in accordance with the Technical Standards. Provide each entrance to the site with a stone tracking pad at least 50 feet in length with a minimum thickness of 12 inches. The tracking pad shall be the full width of the egress point. Inspect tracking pads on a daily basis and replace aggregate when no longer effective. B. If necessary, provide a crushed aggregate paved parking area. C. If applicable, wash water shall be discharged to sedimentation basins, sedimentation vessels, or other such control areas. Untreated wash water shall not be routed to storm sewers or waters of the state.

3.05 MAINTENANCE

A. Contractor shall inspect all erosion control measures within 24 hours of the end of each rainfall event that exceeds 0.25”, or daily during periods of prolonged rainfall, or weekly during periods without rainfall. Immediately repair and/or replace any and all damaged, failed, or inadequate erosion control measures. B. Maintain records of all inspections and any remedial actions taken on-site. C. Remove any sediment reaching a public or private roadway, parking lot, sidewalk, or other pavement. Do not remove tracked sediments by flushing. Completely remove any accumulations not requiring immediate attention at least once daily at the end of the workday. D. Frequently dispose of all waste and unused

construction materials in licensed solid waste or wastewater facilities. Do not bury, dump, or discharge, any garbage, debris, cleaning wastes, toxic materials, or hazardous materials on the site, on the land surface or in detention basins, or otherwise allow materials to be carried off the site by runoff onto adjacent lands or into receiving waters or storm sewer systems.

END OF SECTION

SECTION 31 31 16
TERMITE CONTROL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. Soil poisoning to control subterranean termites.

1.03 RELATED SECTIONS

A. Section 31 20 00 – Earth Moving.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Division 1 specifications. B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit: 1. Materials list of items proposed to be provided under this Section; 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements; 3. Manufacturer's recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. B. Qualifications of subcontractor: 1. Properly licensed to provide such services by governmental agencies having jurisdiction. 2. Not less than five years successful experience in soil treatment for subterranean termites.

1.06 WARRANTY

A. Upon completion of the Work, and as a condition of its acceptance, deliver to the Architect two copies of a Warranty signed by an authorized representative of the installing subcontractor, and co- signed by the Contractor, agreeing: 1. To make an inspection of the Work once each year for total period of five years following Date of Substantial Completion for the purpose of detecting termite infestation; 2. If termite infestation is found during that five year period, to retreat in accordance with prevailing practices of the trade and within ten calendar days after such infestation is discovered; 3. To make such inspections, retreatment, and repairs at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pesticides shall be registered with the Environmental Protection Agency (EPA), or be State registered with EPA approval for use as specified herein. The pesticides shall be water-based emulsions, containing by weight, one of the following concentrations: 1. Torpedo Permethrin: 1.0 percent 2. Imidacloprid (Premise): 0.05 percent 3. Fipronil (Termidor): 0.06 percent B. Diluent shall not include any other pesticide residues or rinsates. The following materials shall not be used:

1. Chlordane 2. Aldrin 3. Heptachlor 4. Chlordane-Heptachlor 5. Chlorpyrifos (Durs ban) C. If combinations of toxicants are approved by governmental agencies having jurisdiction, provide toxicants having such approval and in the maximum strength so approved, at no additional cost to the Owner.

PART 3 EXECUTION

3.01 ENVIRONMENTAL AND SAFETY CONDITIONS

A. Formulation, treatment, storage and disposal of pesticide shall be in accordance with label directions. The filling hose shall be fitted with a backflow preventer meeting local plumbing codes / standards. The filling operation shall be under the direct and continuous observation of a contractor’s representative to prevent overflow.

3.02 SURFACE CONDITIONS

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

3.03 APPLICATION

A. Mixing of materials shall be in accordance with manufacturer's instructions. The following application specified is minimum. If manufacturer's instructions exceed treatment specified, the manufacturer's instructions shall apply. B. Begin soil poisoning only after all preparation for slab placement is complete. C. Slabs on grade: 1. Apply toxicant as an overall treatment at the minimum rate of one gallon of toxicant to each 10 sq. ft of area under slabs on grade within building lines. D. Utility entrances: 1. Apply toxicant at the rate of two gallons of toxicant per five lineal feet at critical locations such as where utilities pass through exterior walls and through floor slabs. 2. Extend treatment not less than 48" from wall into trench. E. Walls: 1. Apply toxicant at the rate of two gallons of toxicant per five lineal feet along both sides of all foundations walls, cross walls, and grade beams, after all nearby excavation has been completed. 2. Apply toxicant at the rate of one gallon of toxicant per five lineal feet to voids in masonry walls. F. Miscellaneous: Apply toxicant at the rate of two gallons of toxicant per five lineal feet at the following areas: 1. Immediately below expansion joints, control joints, and all areas where slab will be penetrated by construction features. 2. Where exterior facings or veneers extend below grade level along the exterior side of all foundation walls. 3. Where unit masonry foundation construction is used. G. If soil is disturbed after treatment, retreat disturbed areas.

END OF SECTION

SECTION 31 63 29
DRILLED CONCRETE PIERS AND SHAFTS

DRILLED CONCRETE PIERS AND SHAFTS PART1 GENERAL

1.01 SECTION INCLUDES

A. Machine drilled shaft. B. Concrete and reinforcement.

1.02 RELATED REQUIREMENTS

A. Section 03 20 00 - Concrete Reinforcing: Requirements for concrete reinforcement. B. Section 03 30 00 - Cast-in-Place Concrete: Requirements for concrete.

1.03 PRICE AND PAYMENT PROCEDURES

A. See Section Unit Prices, for additional unit price requirements. B. Designed Piers: 1. Design Pier Quantity: Determined by the quantity of piers indicated in Contract Documents. 2. Design Pier Length: By the linear foot measured from bearing to top of pier elevation as indicated. 3. Pier Casings: By the linear foot. 4. Pier Reinforcement: By the linear foot of full pier. C. Actual Piers: 1. Actual Pier Quantity: Determined by quantity of piers identified in the Project Record Documents. 2. Actual Pier Length: Determined by length of piers identified in Project Record Documents. a. Base measurement on total linear measurement of pier from bearing to top of pier, overdrilling by contractor is not a basis for additional payment. D. Adjustments to the Contract Sum/Price will be made if the Actual Pier Quantity or Length differs from Design Pier Quantity or Length, based on unit prices established in the Agreement and as follows: 1. Actual Pier Quantity. 2. Actual Pier Length. 3. Unit price per unit length. To calculate cost adjustment, multiply unit price by difference between Design Pier Length and Actual Pier Length. E. Determination of Unit Measurements: Identified by site measurements and verified by special inspector.

1.04 REFERENCE STANDARDS

A. ACI 336.1 - Specification for the Construction of Drilled Piers; 2001. B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014. C. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018. D. ASTM A929/A929M - Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe; 2017.

PART 2 PRODUCTS

2.01 MATERIALS

A. Casing: Temporary casings of steel conforming to ASTM A283/A283M, Grade C; ASTM A36/A36M; or ASTM A929/A929M; of sufficient strength to withstand handling and drilling stresses, concrete pressures, and surrounding earth and water pressures. B. Concrete Materials and Mix: Specified in Section 03 30 00.

PART 3 EXECUTION

3.01 PREPARATION

A. Protect structures near the work from damage. B. Grade perimeter of pier and shaft area to prevent surface water from draining into soil borings. Provide temporary means and methods, as required, to maintain surface diversion until no longer needed, or as directed by the Architect.

3.02 INSTALLATION

A. Construct piers in accordance with ACI 336.1. B. Drill vertical pier shafts to diameters and depths indicated. C. Place steel casings immediately after drilling. Set firmly in place. If casing is to be temporary, install shaft liner with sufficient strength to withstand concrete pressures. D. Clean shaft and bottom of loose material. Provide temporary means and methods, as required, to remove all water from soil borings as needed, or until directed by the Geotechnical Engineer. E. Allow inspection of shaft and liner prior to placement of reinforcement and concrete. F. Place reinforcing steel in accordance with Section 03 20 00. G. Place concrete in single pour, in accordance with Section 03 30 00 with equipment designed for vertical placement of concrete. H. Coordinate casing withdrawal with concrete placement so that concrete pressure head exceeds anticipated outside soil and water pressure above bottom of casing at all times during withdrawal. I. Set tops of piers to elevations indicated.

3.03 TOLERANCES

A. Install piers with maximum variation from location, plumbness, bottom area, diameter, and anchorage locations as specified in ACI 336.1. B. Maximum Variation From Vertical: 1 in 48. C. Maximum Variation From Design Top Elevation: Plus 3 inches, minus 1 inch. D. Maximum Out-of-Position: 2 inches.

3.04 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed as indicated on drawings.

3.05 UNACCEPTABLE PIERS

A. Unacceptable Piers: Piers that fail, are placed out of position, are below elevations, or are damaged. B. Provide additional piers or replace piers failing to conform to specified requirements.

END OF SECTION

SECTION 32 12 14
COMPACTED AGGREGATE BASE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. This work consists of placing lifts of aggregate material on the subgrade. In some cases the new base is placed over an existing surface. In order for the surface of the base to be accurate, the subgrade on which it is to be placed must be set to true line and grade. The subgrade shall be checked for trueness to line and grade before work begins. All material used, construction methods and testing procedures shall be in accordance with the appropriate sections of ODOT Standard Specifications for Highway Construction.

1.03 RELATED SECTIONS

A. Section 32 13 13 – Portland Cement Concrete Paving.

PART 2 - PRODUCTS

2.01 MATERIAL

A. The aggregate material to be used shall meet the requirements of ODOT Standard Specifications for Highway Construction, Section 703.01 – Aggregate Base – TYPE A. The gradation requirements are as follows: Sieve Size (Square) Percent Passing 1 ½ in. 100 ¾ in. 40 – 100 3/8 in. 30 – 75 No. 4 25 – 60 No. 10 20 – 43 No. 40 8 – 26 No. 200 * 4 – 12 • NOTE: The material passing the No. 200 sieve shall not be greater than 2/3 of the amount of material passing the No. 40 sieve. B. See Section 703.01 of the ODOT Specifications for additional requirements including the abrasion testing requirements.

PART 3 – EXECUTION

3.01 PLACING BASE

A. The aggregate is to be spread uniformly over the subgrade. Check the surface for trueness. When the base has been brought to finish elevation and density, a prime coat is to be applied to seal in the proper amount of moisture and seal out any additional moisture to preserve the density of the base.

3.02 TESTING

A. The aggregate is to be tested by taking at least one sample per source and one sample for each 800 Cubic Yard in place. The samples are to be tested as specified in Section 703.01 of the ODOT Specifications.

END OF SECTION

SECTION 32 12 15
STABILIZED SUBGRADE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. Preparing the area to be stabilized and scarifying the subgrade. B. Applying lime or fly ash and uniformly blending the mixture, adding water as required for reaction and proper moisture content. C. Compacting, finish grading and protecting subgrade.

1.03 RELATED SECTIONS

A. Section 31 20 00 – Earth Moving. B. Section 32 13 13 – Portland Cement Concrete Paving.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Division 1 Specifications. B. Testing Services: By independent commercial testing laboratory employed and paid by Contractor, acceptable to Engineer.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner. C. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the Architect. D. Testing Services: By independent commercial testing laboratory employed and paid by Contractor, acceptable to Engineer. E. Moisture-Density Relations of Soils: ANSI/ASTM D 698 (Standard Proctor Method). F. Rates of Materials Applications: 1. The rate of application of lime for the soil-lime mixture shall be based on laboratory tests (estimated by the testing laboratory to be between 5 and 7 percent by dry weight of the nontreated soil). Sufficient lime shall be used to reduce the P.I of the subgrade soil to less than 18. Lime application rate shall be determined as specified in "SAMPLING AND TESTING". 2. The rate of application of fly ash for the soil-fly ash mixture shall be based on laboratory tests (estimated by the testing laboratory to be between 15 and 17 % by dry weight of the nontreated soil). Sufficient fly ash shall be used to reduce the P.I. of the subgrade soil to less than 18. Fly ash application rate shall be determined as specified in "SAMPLING AND TESTING".

1.06 PROJECT CONDITIONS

A. Confine equipment, apparatus, materials, storage and operations of workers to limits provided by law, ordinances, permits, contract documents, and as directed. B. Keep dirt, dust, noise, and other objectionable nuisances arising from grading operations to a minimum.

C. Equipment: Type approved prior to use, with proven capability to perform work in acceptable manner, as recommended by manufacturer for use intended. Perform compaction using tamping rollers, pneumatic tired rollers, three-wheeled power rollers, or other approved type equipment. Protective equipment, apparel, and barriers shall be provided to protect the eyes, respiratory system, and the skin of workers exposed to contact with lime dust or slurry.

1.07 WEATHER LIMITATIONS

A. Lime or fly ash shall not be applied when the atmospheric temperature is less than 40□ F. No lime or fly ash shall be applied to soils that are frozen or contain frost. If the temperature falls below 35□ F, completed lime or fly ash-treated areas shall be protected against any detrimental effects of freezing.

PART 2 - PRODUCTS

2.01 LIME

A. Lime shall be a standard brand of hydrated lime or pelletized quicklime conforming to the following physical and chemical requirements: 1. Lime shall be of such gradation that 99½% passes a No. 20 sieve and a minimum of 85% passes a No. 100 sieve. 2. Combined calcium oxide and magnesium oxide shall be not less than 70%.

2.02 FLY ASH

A. Fly ash shall meet the requirements of ASTM C 618, Class C. 1. The product of only one plant shall be used on the project. This plant shall be identified to the Architect. 2. The Contractor shall provide suitable means of storing and protecting the fly ash against contamination and dampness. Fly ash which has become partially set, contains lumps of caked fly ash or has been contaminated will be rejected.

2.03 OTHER MATERIALS

A. Material to be Stabilized: Material shall be free of deleterious substances such as sticks, debris, organic matter, and stones greater than 3 inches in any dimension. B. Water: Water shall be clean, fresh, and free from injurious amounts oil, acid, salt, alkali, organic matter, and other substances deleterious to the lime or soil-lime mixture, and shall be subject to approval.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

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

3.02 FINISH ELEVATIONS AND LINES

A. Comply with pertinent provisions of the Division 1 Specifications. B. Establish and identify required lines, levels, contours and datum.

3.03 PROTECTION

A. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site. B. Maintain access to adjacent areas at all times.

3.04 PREPARATION

A. Grading: 1. Provide line and grade stakes as necessary for control. 2. Prepare all pavement areas to be stabilized to approximate subgrade elevations in accordance with Section 31 20 00.

3. Grade the entire area to approximately conform to the lines, grades, and cross sections shown. 4. Provide adequate drainage during the entire construction period to prevent water from collecting or standing on the area or on pulverized, mixed, or partially mixed material. B. Debris and Unsatisfactory Material: 1. Clean the area of debris. Soft or yielding subgrade areas shall be made stable before construction is begun. 2. The area shall be capable of the compaction specified for the soil mixture. 3. Dispose of debris and removed unsatisfactory in-place material as specified. C. Scarification: 1. Prior to application of lime or fly ash, scarify the in-place soil and pulverize as necessary with no stones or lumps larger than 1 inch in any dimension to a sufficient width and depth to obtain a uniform mixture of soil, lime or fly ash, and water and to form a compacted subgrade conforming to the cross section indicated. 2. Carefully control scarification so that the layer beneath the layer to be treated is not disturbed. 3. Shape pulverized material to approximately the cross section indicated.

3.05 LIME APPLICATION AND MIXING

A. Lime Application: 1. Apply lime at the specified rate. Equipment used for spreading lime shall be approved type which will distribute the lime at controlled uniform rates. 2. Apply lime in a slurry. a. Slurry shall consist of a minimum mixture of approximately one ton of lime to each 500 gallons of water and shall not contain more than 40% lime. b. Use distributors equipped with a pump in applying slurry. Apply slurry through the spray bars under pressure. 3. No equipment except that used in spreading and mixing shall pass over the freshly applied lime. B. Mixing: 1. Immediately after the lime has been distributed, add the required amount of water and mix the lime, water and soil. a. Add sufficient water to insure chemical action between the lime and soil, and to achieve the desired compaction and moisture content of the finished subgrade. Water shall be incrementally incorporated and simultaneously intermixed into the soil. b. Initial mixing shall be sufficient to produce a uniform mixture and reduce all clods and nonaggregate lumps to a maximum of 2.5 inch diameter size. c. After the last portion of water has been added, mixing shall be continued until the water is uniformly distributed throughout the full depth of the mixture. Take particular care to ensure satisfactory moisture distribution along the edges of the section. 2. Cure mixture after initial mixing has been completed. Maintain material in a moist condition during the curing period. a. Cure 72 hours at temperatures above 32oF when hydrated lime is used. b. Cure 48 hours at temperatures above 32oF when quick lime is used. 3. Determine moisture content of the mixture prior to final mixing and add water as required.

Moisture in the mixture following final mixing shall be between optimum and 3% above optimum. 4. Before compaction operations are started and as a continuation of the mixing operation, thoroughly loosen and pulverize the mixture to the full depth. The soil-lime mixture shall be reduced in size to meet the following requirements when tested dry by laboratory sieves: Min. passing 1½ inch sieve - 100%; Min. passing No. 4 sieve - 60%.

3.06 FLY ASH APPLICATION AND MIXING

A. Fly Ash Application: 1. Apply fly ash at the specified rate. Use mechanical spreaders in applying bulk fly ash. Equipment used for spreading fly ash shall be approved type which will distribute the fly ash at

controlled uniform rates. 2. Do not apply fly ash by the slurry method. Do not place fly ash on wet subgrade or otherwise allow fly ash to become wet during application. B. Mixing: 1. Immediately after the fly ash has been distributed, mix the fly ash and soil. a. The moisture content of the subgrade soil shall not exceed 80% of optimum as determined by ASTM D 698 at the time of first mixing. b. Do not add water during the first mixing. c. Mix the soil and fly ash until a uniform mixture is obtained in which all clods and non- aggregate lumps are reduced to a maximum of 2.5 inch diameter size. 2. After the first mixing is satisfactorily completed, add water to initiate soil-fly ash reaction and proceed with the final mixing operations. a. Add sufficient water to insure chemical action between the fly ash and soil, and to achieve the desired compaction and moisture content of the finished subgrade. Moisture in the mixture following final mixing shall be between optimum and 3% above optimum. Water shall be incrementally incorporated and simultaneously intermixed into the soil. b. After the last portion of water has been added, mixing shall be continued until the water is uniformly distributed throughout the full depth of the mixture. Take particular care to ensure satisfactory moisture distribution along the edges of the section. c. Before compaction operations are started and as a continuation of the mixing operation, thoroughly loosen and pulverize the mixture to the full depth. The soil-fly ash mixture shall be reduced in size to meet the following requirements when tested dry by laboratory sieves: Min. passing 1½ inch sieve - 100 %; Min. passing 3/4 inch sieve - 50%.

3.07 COMPACTING

A. Start compaction immediately after mixing is completed. During final compaction, the surface shall be moistened, if necessary, and shaped to the required lines, grades, and cross section. B. Begin rolling at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. The speed of the roller at all times shall be such that displacement of the mixture does not occur. C. Compact areas inaccessible to the rollers with mechanical tampers, and shape and finish by hand methods. D. Final compacted thickness of the subgrade shall be as indicated. No layer shall be in excess of 8 inches or less than 3 inches in compacted thickness. E. Place approved material along the edges of the course in such quantity as will compact to the thickness of the course being constructed, allowing at least a 1-foot width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of the subgrade. F. Control soil compaction during construction to provide the minimum percentage of density specified for each area as determined according to ASTM D 698. G. Provide not less than the following percentage of maximum density of soil material compacted at optimum moisture content (plus or minus two %) for the actual density of each layer of soil material in place, and as approved by the Architect. 1. Pavements: Compact the top 8" of subgrade at 98% of maximum density.

3.08 FINISH GRADING

A. Finish the surface to the grade and cross section shown. The surface shall be of uniform texture. 1. Should the surface for any reason become rough, corrugated, uneven in texture, or traffic-marked prior to completion, such unsatisfactory portions shall be scarified, reworked, relaid, or replaced as directed. 2. Should any portion of the course, when laid, become water soaked for any reason, that portion shall be removed immediately, and the mix placed in a windrow and aerated until a

moisture content within the limits specified is obtained, and then spread, shaped, and rolled as specified above. B. Completed thickness of the subgrade course shall be not more than 2 inch below the thickness indicated. 1. Where more than 2 inch deficient, such areas shall be corrected by scarifying, adding proper mixture, reblading, and recompacting as directed. 2. The average of all thickness measurements taken for the job shall be within 1/4 inch of the thickness indicated. C. At the end of each phase of construction, form a straight transverse construction joint by cutting back into the completed work to form a true vertical face free of loose or shattered material. Material along construction joints not properly compacted shall be removed and replaced with soil-lime or soil-fly ash mixture that is mixed, moistened, and compacted as specified.

3.09 PROTECTION

A. Opening to Traffic: 1. Completed portions of the subgrade may be opened immediately to light traffic provided the curing is not impaired. Heavy equipment shall not be permitted on the area during the curing period. Stabilizing material and water may be hauled over the completed area with pneumatic-tired equipment if approved. 2. After the curing period, completed areas may be opened to all traffic, provided the course has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic. 3. Finished portions of the surface that are traveled on by equipment used in constructing an adjoining section shall be protected in a manner to prevent equipment from marring or damaging completed work.

3.10 MAINTENANCE

A. Maintain the subgrade in a satisfactory condition until the completed work is accepted. 1. Maintenance shall include immediate repairs of any defects and shall be repeated as often as necessary to keep the area intact. 2. Defects shall be corrected as specified herein.

3.11 DISPOSAL OF UNSATISFACTORY MATERIALS

A. Dispose removed in-place materials that are unsuitable for stabilization, material that is removed for the required correction of defective areas, waste material, and debris away from the site.

3.12 SAMPLING AND TESTING

A. Secure the testing laboratory's inspection and approval of subgrade before subsequent construction is permitted thereon. B. Density Tests and Reports: 1. Field in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017, the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and in intervals as directed by the Architect. 2. ASTM D 2937, the Drive Cylinder Method shall be used only for soft, fine-grained, cohesive soils. 3. Within 24 hours of conclusion of physical tests, 2 copies of test results, including calibration curves and results of calibration tests, shall be furnished to the Architect. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the

engineer and that the results are representative of the materials or conditions being certified by the tests. C. Laboratory Testing: 1. Tests shall establish the percentage of lime for the soil-lime mixture, expressed as a percent by dry weight of the nontreated soil. A minimum of four samples, each with a different percentage of lime, shall be prepared. The resulting liquid limit and plasticity index shall be determined in accordance with AASHTO T 89 and T 90. 2. Tests shall establish the percentage of fly ash for the soil-fly ash mixture, expressed as a percent by dry weight of the nontreated soil. A minimum of four samples, each with a different percentage of fly ash, shall be prepared. The resulting liquid limit and plasticity index shall be determined in accordance with AASHTO T 89 and T 90. 3. Laboratory density tests shall establish the dry weight of nontreated soil at optimum moisture content and shall also provide a moisture-density relationship for the lime-soil or fly ash-soil mixture. Tests shall be conducted in accordance with ASTM D 698. D. Field Quality Control: 1. In-Place Density and Moisture Content of Subgrades: a. One test per 1,000 square yards or fraction thereof of each layer of stabilized subgrade under pavements. 2. Thickness measurements shall be made in 3-inch-diameter test holes penetrating the treated course. 3. The surface of the stabilized layer shall show no deviations in excess of 3/8 inch when tested with a 10 foot straightedge. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting, as directed by Architect. E. If, in the Architect's opinion based on reports of the testing laboratory, subgrades which have been placed are below specified density, provide additional compacting and testing.

END OF SECTION

SECTION 32 13 13
PORTLAND CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. Portland cement concrete paving.

1.03 RELATED SECTIONS

A. Section 31 20 00 – Earth Moving. B. Section 32 12 14 – Compacted Aggregate Base. C. Section 32 12 15 – Stabilized Subgrade. D. Section 32 13 14 – Concrete Sidewalks, Curbs and Gutters. E. Section 32 12 17 – Pavement Marking.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Division 1 Specifications. B. Joint Layout: Submit joint layout if proposed jointing differs from layout shown on the Drawings.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods for proper performance of the work of this Section. B. Equipment: Type approved prior to use, for capability of equipment to perform acceptable work. C. Do not commence placement of concrete until mix designs have been reviewed and approved by the Engineer and all governmental agencies having jurisdiction, and until copies of the approved mix designs are at the job site and the batch plant. D. Provide access for, and cooperate with, the inspector and testing laboratory. E. Testing Services: By independent commercial testing laboratory employed and paid by Contractor, acceptable to Engineer. F. Reference Standards: Referenced portions of Oklahoma Department of Transportation “Standard Specifications for Highway Construction”, Latest Edition as amended to date, as referenced herein as “ODOT Specifications”.

1.06 PROJECT CONDITIONS

A. Confine equipment, apparatus, materials, storage and operations of workers to limits provided by law, ordinances, permits, contract documents, and as directed.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide forms, reinforcement, concrete, curing, and other materials as specified in ODOT Specifications Section 414, “Portland Cement Concrete Pavement”, and as required in this Section. B. Where conflicts occur between the requirements of ODOT Section 414 and this Section, requirements of this Section shall take precedence. C. Concrete: 28-day compressive strength of 3500 psi.

2.02 BAR MATS, DOWELS, AND TIE BARS

A. Bar Mats: Deformed steel bar mats conforming to ASTM A 184, grade 40 or 60.

B. Dowels: Plain steel bars conforming to ASTM A 615, grade 40 or 60. C. Tie Bars: Deformed steel bars conforming to ASTM A 615, grade 40 or 60; except that grade 60 bars shall not be used for bars that are bent and straightened during construction.

2.03 JOINT FILLER

A. Expansion Joints: Filler shall be preformed materials conforming to ASTM D 1751 or ASTM D 1752. B. Contraction Joints: Contraction joint inserts shall have sufficient stiffness to permit placement in plastic concrete without undue deviation from a straight line. Insert materials shall conform to ASTM D 2628.

2.04 EPOXY RESIN

A. Two-component materials conforming to the requirements of ASTM C 881, class as appropriate for each application temperature to be encountered. B. Materials for bonding freshly mixed portland cement concrete or mortar or freshly

mixed epoxy resin concrete or mortar to hardened concrete shall be Type II materials, grade as approved by the Engineer. C. Materials for use as patching materials for complete filling of spalls, wide cracks, and other voids; for use for embedding dowels and anchor bolts; and for use as a binder in preparing epoxy resin mortars and concretes shall be Type III materials. 1. Bond strength at 14 days (moist cure) shall be at least 1000 psi. 2. Volatile content, cured system, shall not exceed 3%. 3. Grade shall be as approved by the Engineer except that Grade 3 shall be used for embedding dowels in hardened concrete.

2.05 JOINT SEALANT

A. Seal joints with silicone sealant, ODOT Section 701.08. B. Separating and Blocking Medium: Separating and blocking material used to seal off the lower portion of the joint shall be a readily compressible, nonshrinkable rope plastic or rubber not reactive with the sealant. The separating and blocking medium shall not soften or melt at pouring temperature of the sealant. C. Bond Breaker Tape: The bond breaker medium shall be a flexible, nonshrinkable, nonabsorptive, and nonreactive adhesive-backed tape. The bond breaker tape shall be 1/8-inch wider than the nominal width of the joint.

2.06 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

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

3.02 PREPARATION

A. See Section 31 20 00 and 32 12 15 for prior work. B. Repair and recompact to 95% of Standard Proctor Density subgrade disturbed and not satisfactory or subgrade softened to extent that it does not have specified density and proper moisture content. C. Shape to line, grade, and cross-section.

3.03 SETTING FORMS

A. Comply with requirements of ODOT Specification Section 414 and the following:

1. Install sufficient quantity to allow continuous progress of work, and so forms can remain in place for 24 hours minimum after concrete placement. 2. Check completed formwork for grade and alignment, do not exceed following tolerances: a. Top of Forms: Not more than 1/8" in 10'-0". b. Vertical Face: Longitudinal axis, not more than 1/4" in 10'-0".

3.04 PLACING REINFORCEMENT

A. Install in compliance with the requirements of ODOT Specification Section 414.

3.05 INSTALLING DOWELS AND TIE BARS

A. Install in compliance with the requirements of ODOT Specification Section 414. 1. When bending tie bars, the minimum radius of curvature recommended for the particular grade of steel cited in the appropriate standard shall be used. Before placement of the adjoining lane, the tie bars will be straightened. B. Fixed-Form Installation: 1. Fixed-form installation of dowels and tie bars shall be by the bonded-in-place method. 2. Tie bars and dowels shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations. 3. Dowels in longitudinal and transverse construction joints shall be held securely in place parallel to the surface, as indicated, by means of devices fastened to the form. 4. Dowels in expansion joints and tie bars and dowels installed within the paving lane shall be held securely in place, as indicated, by means of rigid metal frames or basket assemblies of approved type. 5. Dowels in longitudinal joints shall be omitted when the center of the dowel is located within a horizontal distance from a transverse joint equal to one-fourth of the slab thickness. C. Slipform Installation: 1. Dowels in longitudinal construction joints shall be placed by bonding the dowels into holes drilled into the hardened concrete. a. Holes approximately 1/8-inch greater in diameter than the dowels shall be drilled with rotary-type core drills that must be held securely in place to drill perpendicularly into the vertical face of the pavement slab. b. Dowels shall be bonded in the drilled holes using an epoxy resin material. c. Installation procedures shall be adequate to ensure that the area around dowels is completely filled with epoxy grout. 2. Dowels in expansion and contraction joints installed within the paving lane shall be held securely in place by means of rigid metal frames or basket assemblies of the type used in the method described in requirements for fixed-form installation. 3. Tie bars installed within the paving lane shall be held

securely in place by means of rigid metal frames or basket assemblies as required by fixed-form installation. 4. When tie bars are specified in longitudinal construction joints, bent tie bars shall be installed in front of the paver by insertion into the unconsolidated plastic concrete through a 26-gauge metal keyway liner. a. Tie bars shall not be installed in the plastic concrete after the concrete has been consolidated and the cross section formed. Tie bars shall not be installed in preformed holes in hardened concrete. b. The keyway liner shall remain in place and become part of the joint.

3.06 PLACING CONCRETE

A. General: 1. Construct in one course in conformity with lines, grade, thickness and typical sections shown on the Drawings and in compliance with the requirements of ODOT Specifications Section 414. 2. Place concrete between stationary forms or construct to the desired cross section using slipform pavers.

3. Concrete placement shall be continuous and at a uniform rate without unscheduled stops except for equipment failure or other emergencies. B. Slipform Method: 1. Slipform paver shall be self-propelled, automatically controlled, crawler-mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in one pass. 2. Paver shall be capable of finishing the surface and edges so that a minimum amount of hand finishing is required, and shall have sufficient weight and power to handle the amount of concrete required for the full-lane width as specified. 3. Horizontal and vertical alignment shall be referenced to a taut wire or string line. 4. Vibrators or tamping elements shall be automatically controlled so that they shall be stopped as forward motion ceases. 5. When the paver approaches a header at the end of a paving lane, a sufficient amount of concrete shall be maintained ahead of the paver to allow a roll of concrete to spill over the header. C. Spreading: 1. Spreading shall be by machine method. Hand spreading will be permitted only where required for odd widths or shapes of slabs. 2. Mechanical spreaders shall be designed and operated to distribute the plastic concrete uniformly across the full width of the paving lane.

3.07 CONSOLIDATION

A. Consolidate concrete immediately after placing in compliance with the requirements of ODOT Specifications Section 414. B. Use internal vibrating units or a vibratory finishing machine. C. Internal Vibrating Units: 1. Number of units and the power of each unit shall be adequate to properly consolidate the concrete with the vibration spacing used. 2. Vibrating unit shall be mounted on a frame or on the paver and equipped with suitable controls so that all vibrators may be operated at any desired depth within the slab or completely withdrawn from the concrete, as required. 3. Spacing of vibrating units that extend into the slab at intervals across the paving lane shall be as necessary to properly consolidate the concrete, but the clear distance between the units shall not exceed 30 inches. 4. Outside elements shall be approximately 1 foot from the edge of the slab. D. Vibratory Finishing Machine: 1. Power operated approved type. 2. Vibratory template shall be two feet longer than slab width and designed to vibrate and consolidate freshly struck off concrete to required grade. Template shall be steel, shaped to crown or slope of pavement, with a face at least 3½" in width.

3.08 FINISHING

A. General: 1. Finish pavement in compliance with the requirements of ODOT Specifications Section 414 and this Section. 2. Finishing shall be by the machine method except where otherwise indicated; the hand method will be permitted on odd slab widths or shapes and in event of breakdown of the mechanical equipment, to finish concrete. 3. Excessive manipulation that brings mortar and water in excess of 1/8-inch thick to the surface will not be permitted, and any equipment that does not produce the required compaction and surface finish will be considered unsatisfactory. B. Machine Finishing with Fixed Forms: 1. Finishing machine shall be designed and operated to strike off, screed, and consolidate the concrete.

2. Finishing machine shall make as many trips over each area of pavement as necessary to compact the concrete and produce a surface of uniform texture, true to grade. Water shall not be added to the concrete used to fill low spots or to facilitate finishing operations. 3. After completion of screeding, the mechanical float shall be operated to smooth and finish the pavement to grade. The float shall be operated so as to maintain contact with the surface at all times. C. Finishing by Slipform Method: 1. Slipform paver shall be capable of finishing the surface and edges so that only a minimum of additional work is necessary. 2. A self-propelled pipe float may be used if the Contractor desires, while the concrete is still plastic, to remove minor irregularities and score marks. Pipe floating will be accomplished as soon as possible and discontinued immediately after a uniform surface appearance is achieved. 3. Concrete slurry permitted to run down the vertical edges of the slipped concrete will be removed by hand, using stiff brushes or other approved scrapers. 4. Wood or metal forms shall be available for use in repairing edges that slough excessively. D. Hand Finishing: 1. The entire surface shall be tamped, and the tamping operation continued until the required compaction and reduction of internal and surface voids are accomplished. 2. Immediately following the final tamping of the surface, the pavement shall be floated

longitudinally from bridges resting on the side forms and spanning but not touching the concrete. 3. If necessary, additional concrete shall be placed and screeded, and the float operated until a satisfactory surface has been produced. E. Texturing: 1. Before the surface sheen has disappeared and before the concrete becomes nonplastic, the surface of the pavement shall be given a texture by one of the following methods: 2. Burlap-Drag Texture: a. Surface texture shall be applied by dragging the surface of the pavement, in the direction of the concrete placement, with an approved multiple-ply burlap drag at least 3 feet in width and equal in length to the width of slab. b. The dragging shall produce a uniform finished surface having a fine sandy texture without disfiguring marks. 3. Wire Comb Texture: a. Surface texture shall be applied using an approved wire comb. b. The wire comb shall be operated mechanically with the length of the comb parallel to the pavement center line. c. Successive passes of the comb shall be overlapped the minimum necessary to obtain a continuous and uniformly textured surface. d. Texturing shall be completed before the concrete has dried to the point where the surface and edges will be unduly torn, but after drying has progressed to the point where the serrations will not close up. e. Serrations shall be 1/16- to 3/16-inch deep, 1/16- to 1/8-inch wide, and spaced 1/4- to ½ inch apart. 4. Broom Texturing: a. Surface texture shall be applied using an approved hand or mechanical stiff bristle broom of a type that will produce uniform corrugations. b. Broom shall be operated with the length of the broom parallel to the pavement center line. c. Successive passes of the broom shall be overlapped the minimum necessary to obtain a uniformly textured surface. d. Brooms shall be washed thoroughly and dried at frequent intervals during use.

e. Brooming shall be completed before the concrete has dried to the point where the surface will be unduly torn or roughened, but after drying has progressed enough so that the mortar will not flow and attenuate the sharpness of the corrugations. f. Corrugations shall be uniform in appearance and approximately 1/16-inch in depth but not more than 1/8-inch in depth. F. Edging: 1. After texturing has been completed, the edge of slabs along the forms, along the edges of slipformed lanes and at the joints shall be carefully finished with an edging tool to form a smooth rounded surface of the required radius. 2. Tool marks shall be eliminated, and the edges shall be smooth and true to line.

3.09 JOINTS

A. General: 1. Joints shall be of the type and location shown on the Drawings. Where not shown, contraction joints shall divide the pavement into equal size squares or into equal size rectangles whose longest side is no more than 1.25 times the shortest side. The maximum length of any side shall be 15 feet. 2. Joints shall conform to the details indicated and shall be perpendicular to the finished grade of the pavement. 3. Transverse expansion and contraction joints shall be straight and continuous from edge to edge of the pavement. 4. Place transverse joints to align with existing joints where new paving joins existing paving, unless otherwise shown. B. Longitudinal Construction Joints: 1. When the concrete is placed using stationary forms, metal forms securely fastened to the concrete form shall be used to form the keyway in the plastic concrete. 2. When the concrete is placed using slipform pavers, the keyway shall be formed in the plastic concrete by means of metal forms permanently attached to the side forms or by means of preformed metal keyway liners, which are inserted during the slipform operations and shall be left in place. 3. Longitudinal construction joints shall be edged and subsequently sawed to provide a groove at the top conforming to the details and dimensions indicated. C. Transverse Construction Joints: 1. Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for 30 minutes or longer. These joints shall be located at a planned joint. 2. Transverse construction joints shall be doweled, one-half of each dowel painted and oiled to permit movement at the joint. 3. Transverse construction joints shall be edged and subsequently sawed to provide a groove at the top conforming to the details and dimensions indicated. 4. When using slipform pavers, transverse construction joints shall be constructed by utilizing headers, hand placement, and finishing techniques. D. Expansion Joints: 1. Expansion joints shall be formed by means of a preformed filler material. 2. Filler shall be securely held in position by means of approved metal supports, which shall remain in the pavement. 3. A removable metal-channel cap bar shall be used to hold the parts of the joint in proper position and protect the filler from damage during concreting operations. The cap bar shall be removable without damage to the pavement to provide a space for sealing of the joint. 4. Expansion joints shall be formed about structures and features that project through, into, or against the pavement, using joint filler of the type, thickness, and width indicated, and shall be installed in such manner as to form a complete, uniform separation between the structure and the pavement. E. Contraction Joints:

1. Transverse and longitudinal contraction joints shall be of the weakened-plane or dummy type and shall be constructed as indicated, with a depth equal to 1/4 slab thickness unless otherwise detailed. 2. Longitudinal contraction joints shall be constructed by sawing a groove in the hardened concrete in conformance with requirements for sawed joints unless otherwise approved. 3. Transverse contraction joints shall be constructed in conformance with requirements for sawed joints or insert-type contraction joints, unless otherwise approved. F. Sawed Joints: 1. Sawed joints shall be constructed

by sawing a groove in the concrete with a 1/8-inch blade to the full depth as indicated. 2. After expiration of the curing period, the upper portion of the groove shall be widened by sawing to the width and depth indicated. 3. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. 4. Saw cut shall not vary more than ½ inch from the true joint alignment. 5. Joint shall not be sawed if a crack has occurred near the planned joint location or when a crack develops ahead of the saw cut. 6. Immediately after the joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water until all waste from sawing is removed from the joint. 7. Membrane-cured surface damaged during the sawing operations shall be resprayed as soon as the surface becomes dry.

3.10 CURING

A. Cure finished pavement in compliance with the requirements of ODOT Specifications Section 414.

3.11 SEALING JOINTS

A. Seal joints in accordance to ODOT Specifications B. Sandblast Cleaning: 1. Joint faces and the pavement surfaces extending about ½ inch from the joint edges shall be sandblast cleaned. 2. A multiple-pass technique shall be used until the surfaces are free of saw-cutting fines that might prevent bonding of the sealant to the concrete. 3. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of sand and water. C. Separating and Blocking Media: 1. Lower portion of the groove shall be sealed off to prevent entrance of the sealant below the depth specified. 2. The blocking medium shall not be stretched during insertion in the joint. D. Bond Breaker Tape: 1. Bond breaker tape shall be installed on top of expansion joint material. 2. The tape shall be securely bonded so it will not float up into the new sealant. E. Sealing: 1. Joints shall be sealed immediately following final cleaning of the joint walls and following the placement of separating and blocking media. 2. Joints shall be filled from the bottom up to within 1/8-inch of the pavement surface using specified equipment. 3. Excess or spilled sealant shall be removed from the pavement by approved methods and shall be discarded. 4. Traffic shall not be permitted over newly sealed pavement until authorized by the Engineer. 5. When a primer is supplied by the manufacturer of a sealant, it shall be applied evenly to the joint faces in accordance with the manufacturer's recommendations.

3.12 INTEGRAL CURBS

A. Integral curbs shall be constructed to dimensions and at locations indicated. Maximum nominal size of the coarse aggregate for curb construction shall be 1½ inches. B. Forms for Integral Curbs: 1. Forms for curbs shall be of similar material to that used for pavement. 2. Outside form shall be of a depth equal to the combined depth of the integral curb and the pavement slab. 3. Inside curb-face form shall have a batter from the top of the curb to the finished pavement surface as indicated. 4. Inside curb form shall be securely fastened to and supported by the outside form. Fastenings shall not obstruct the satisfactory finishing and edging of the top of the curb and shall permit early removal of the face form. C. Placing: 1. Concrete curb shall be placed as soon as practical after the slab is placed, but in no case shall the time between the placing of the slab and the placing of the curb exceed 45 minutes. 2. Concrete shall be thoroughly spaded or vibrated until well compacted and until a good bond is obtained between the curb and the slab. D. Joints: 1. Joints shall be of the type and construction specified for the pavement slab on which the curb is placed. 2. Pavement joints shall extend through the curb except that horizontal dowels will not be required between joints in the curb. E. Finishing Curbs: 1. Top of the curb shall be floated to compact the concrete thoroughly and produce a smooth even surface. 2. Edges of the curb and joints shall be rounded by using appropriate edging tools. 3. Vertical edges of joints shall be dressed when the curb form is removed. 4. While the concrete is green, the top and face of the curb shall be finished by rubbing the surface with a wood or concrete rubbing block and water until all blemishes, form marks, and tool marks are removed. 5. Rubbed surface shall then be brushed with a fine-textured brush to obtain a uniform sandy texture, free from humps, sags, and other irregularities. 6. Top and face of the curb shall not vary more than 1/8-inch from the edge of a 10-foot straightedge, except at grade changes or curves.

3.13 CONCRETE PAVING REPAIRS

A. Repair concrete in compliance with the requirements of ODOT Specifications Section 414 and this Section. B. Defective concrete shall be removed and replaced at the Contractor's expense if, in the opinion of the Engineer, it cannot be adequately repaired. C. Removal and Replacement of Defective Concrete: 1. In no case shall the removal and replacement of concrete result in a slab less than a full paving lane width or a joint less than 10 feet from a regularly scheduled transverse joint. 2. Defective concrete shall be removed carefully so that the adjacent pavement will not be damaged and the existing keys or dowels at the joints will be left intact. 3. When a portion of the unfractured slab is

replaced, a saw cut 4-inches deep shall be made transversely across the slab in the required location, and the concrete shall be removed to provide an essentially vertical face in the remaining portion of the slab. 4. Prior to placement of the fresh concrete, the face of the slab shall be cleaned of debris and loose concrete, and then thoroughly coated with epoxy-resin. 5. Strips of polyethylene sheeting shall be placed on the vertical joint faces of adjacent slabs at the juncture with the slab to be patched as a bond-breaking medium.

6. Placement of the fresh portland cement concrete shall be accomplished while the epoxy resin is still tacky and in such manner that the grout coating will not be removed. 7. Longitudinal and transverse joints of the replaced slab or portion thereof shall be constructed as indicated and the joints sealed.

3.14 PROTECTION

A. Beginning immediately after placement, protect concrete from mechanical injury. B. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing and curing.

3.15 DISPOSAL

A. Transport debris and excess material from site and legally dispose of them.

END OF SECTION

SECTION 32 13 14
CONCRETE SIDEWALKS, CURBS AND GUTTERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. Portland cement concrete sidewalks. B. Portland cement curbs and gutters.

1.03 RELATED SECTIONS

A. Section 31 20 00 – Earth Moving. B. Section 32 13 13 – Portland Cement Concrete Paving.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Division 1 Specifications. B. Joint Layout: Submit joint layout if proposed jointing differs from layout shown on the Drawings.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods for proper performance of the work of this Section. B. Equipment: Type approved prior to use, for capability of equipment to perform acceptable work. C. Do not commence placement of concrete until mix designs have been reviewed and approved by the Engineer and all governmental agencies having jurisdiction, and until copies of the approved mix designs are at the job site and the batch plant. D. Provide access for, and cooperate with, the inspector and testing laboratory. E. Testing Services: By independent commercial testing laboratory employed and paid by Contractor, acceptable to Engineer. F. Referenced Standards: Referenced portions of Oklahoma Department of Transportation “Standard Specifications for Highway Construction”, Latest Edition as amended to date, as referenced herein as “ODOT Specifications”.

1.06 PROJECT CONDITIONS

A. Confine equipment, apparatus, materials, storage and operations of workers to limits provided by law, ordinances, permits, contract documents, and as directed. B. Coordination: Coordinate this work with the work of other Sections to avoid any delay or interference with other work.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide forms, reinforcement, concrete, curing, and other materials as specified in ODOT Specifications Section 609 and 610 and as required in this Section. B. Where conflicts occur between the requirements of ODOT Specifications Section 609 and 610 and this Section, requirements of this Section shall take precedence. C. Concrete: 28-day compressive strength of 3,500 psi.

2.02 COLOR PIGMENT

A. As where called for on the plans, color pigment shall conform to ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis. 1. Color: One color for special paving in courtyard as selected by Architect from manufacturer’s full range.

2.03 FORMS

A. Use either steel or wood. Use flexible spring-steel forms or laminated boards to form radius bends as required. B. The condition and stability of the forms shall produce a sidewalk, concrete curb, or concrete curb and gutter that will not deviate more than 1/4 inch in 10 feet in either grade or alignment. C. Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk. D. Curb and Gutter Forms: 1. Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. 2. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or

where the central angle is such that a rigid form with a central angle of 90□ cannot be used. Back forms for curb returns may be made of 1½ inch benders, for the full height of the curb, cleated together.

2.04 DOWELS AND TIE BARS

A. Dowels: Plain steel bars conforming to ASTM A 615, grade 40 or 60. B. Tie Bars: Deformed steel bars conforming to ASTM A 615, grade 40 or 60.

2.05 JOINT MATERIAL

A. Expansion Joints: 1. Non-sealed joints: Filler premolded bituminous type conforming to ASTM D1751. 2. Sealed joints: Silicone Sealant ODOT Section 701.08. B. Joint Sealer: Silicone Sealant ODOT Section 701.08.

2.06 EPOXY RESIN

A. Two-component materials conforming to the requirements of ASTM C 881, class as appropriate for each application temperature to be encountered. B. Materials for bonding freshly mixed Portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type II materials, grade as approved by the Engineer. C. Materials for use as patching materials for complete filling of spalls, wide cracks, and other voids; for use for embedding dowels and anchor bolts; and for use as a binder in preparing epoxy resin mortars and concretes shall be Type III materials. 1. Bond strength at 14 days (moist cure) shall be at least 1000 psi. 2. Volatile content, cured system, shall not exceed 3%. 3. Grade shall be as approved by the Engineer except that Grade 3 shall be used for embedding dowels in hardened concrete.

2.07 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

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

3.02 SUBGRADE PREPARATION

A. Grading: 1. Conform with the requirements specified in Section 31 20 00. 2. Shape to line, grade and cross-section. B. Thoroughly wet the subgrade and then compact with two passes of a 500 pound roller. C. Remove yielding material deflecting more than ½" under the specified roller to a depth of not less than 4" below subgrade elevation and replace with an approved granular material compacted as described above. D. The subgrade shall be in a moist condition when the concrete is placed. In cold weather prepare and protect the subgrade so as to provide a subgrade free from frost when the concrete is deposited.

3.03 SETTING FORMS

A. Comply with requirements of ODOT Specifications Section 609 and 610 and the following: 1. Install sufficient quantity of forms to allow continuous progress of the work and so that forms can remain in place at least 24 hours after concrete placement. 2. Check completed form work for grade and alignment to the following tolerances: a. Top of Form: longitudinal axis not more than 1/4" in 10 feet. B. The forms on the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed.

3.04 PLACING REINFORCEMENT

A. Install in compliance with the requirements of ODOT Specification Section 609 and 610.

3.05 INSTALLING DOWELS AND TIE BARS

A. General: 1. The portion of each dowel intended to move within the concrete or expansion cap shall be painted. The painted portion shall be wiped clean and coated with a thin even film of lubricating oil before the concrete is placed. B. Fixed-Form Installation: 1. Fixed-form installation of dowels and tie bars shall be by the bonded-in-place method. 2. Dowels and tie bars shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations. 3. Dowels and tie bars in construction and expansion joints shall be held securely in place parallel to the surface, as indicated, by means of devices fastened to the form. C. Slipform Installation: 1. Dowels in expansion joints shall be held securely in place by means of rigid metal

frames or basket assemblies of approved type. 2. Dowels and tie bars in construction and expansion joints at the end of a run shall be held securely in place parallel to the surface, as indicated, by means of devices fastened to the end form.

3.06 CONCRETE PLACEMENT AND FINISHING

A. General: Comply with the requirements of ODOT Specifications Section 609 and 610 for mixing and placing concrete, and as specified herein. B. Moisten subgrade as required to reduce suction at the time concrete is placed. Do not place concrete around structures until they have been brought to the required grade and alignment. C. Deposit and spread concrete in a continuous operation between transverse joints. If interrupted for more than ½ hour, place a construction joint.

3.07 SIDEWALK CONCRETE PLACEMENT AND FINISHING

A. Formed Sidewalks: 1. Place concrete in the forms in one layer of such thickness that when consolidated and finished the sidewalks will be of the thickness indicated. After concrete has been placed in the forms, use a strike-off guided by side forms to bring the surface to proper section to be compacted. Consolidate the concrete with an approved vibrator, and finish the surface to grade with a wood float, bull float, or darby, edged and broom finished. 2. Concrete Finishing: a. After straight edging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. b. Produce a scored surface by brooming with a fiber-bristle brush in a direction transverse to that of the traffic. 3. Edge and Joint Finishing: a. Finish all slab edges, including those at formed joints, carefully with an edger having a radius of 1/8 inch. Edge transverse joints before brooming, and use brooming to eliminate the flat surface left by the surface face of the edger. b. Clean corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing and fill solidly with a properly proportioned mortar mixture and then finish. B. Slip-Formed Sidewalks: 1. Place concrete to the desired section in a single pass. 2. When the paver approaches a header at the end of a paving lane, maintain a sufficient amount of concrete ahead of the paver to allow a roll of concrete to spill over the header. The amount of extra concrete shall be sufficient to prevent the slurry that is formed and carried along ahead of the paver from being deposited adjacent to the header. Bring the spud vibrators on the front of the paver as close to the header as possible before they are lifted. Provide additional consolidation adjacent to the headers by hand-manipulated vibrators. 3. When the slip form paver is operated between or adjacent to previously constructed slabs, make provisions to prevent damage to the previous construction. Transversely oscillating screeds shall be electronically controlled from the previously placed slab to prevent the screed from applying pressure to the existing concrete. When the paver travels on existing pavement, make provisions to prevent damage to the existing pavement. 4. Finished surface at the edges shall not produce an edge slump exceeding 0.25 inch over 85% of the finished work and 100% of the work shall not have an edge slump exceeding 0.75 inch. C. Surface and Thickness Tolerances: 1. Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. 2. Permissible deficiency in section thickness will be up to 0.25 inch.

3.08 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

A. Formed Curb and Gutter: 1. Place concrete to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. 2. Concrete Finishing: a. Float and finish exposed surfaces with a smooth wood float until true to grade and section and uniform in texture. Brush floated surfaces with a fine-hair brush with longitudinal strokes. b. Round edges of the gutter and top of the curb with an edging tool to a radius of ½ inch. c. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the front curb surface, while still wet, in the same manner as the gutter and curb top. d. The top surface of gutter and entrance shall be finished to grade with a wood float.

3. Joint Finishing: Finish curb edges at formed joints as indicated. B. Curb Forming Machine: 1. Place concrete to the desired section in a single pass. 2. When the paver approaches a header at the end of a paving segment, maintain a sufficient amount of concrete ahead of the paver to allow a roll of concrete to spill over the header. The amount of extra concrete shall be sufficient to prevent the slurry that is formed and carried along ahead of the paver from being deposited adjacent to the header. Bring the paver vibrators as close to the header as possible before they are lifted. Provide additional consolidation by hand-manipulated vibrators when required. 3. When the curb forming machine is operated between or adjacent to previously constructed curbs, make provisions to prevent damage to the previous construction and the machine. 4. Finished surface at the edges shall not produce an edge slump exceeding 0.25 inch over 85% of the finished work and 100% of the work shall not have an edge slump exceeding 0.75 inch. C. Surface and Thickness Tolerances: 1. Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. 2. Permissible deficiency in section thickness will be up to 0.25 inch.

3.09 SIDEWALK JOINTS

A. Construct sidewalk joints to divide the surface into rectangular areas. 1. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. 2. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. 3. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. B. Contraction Joints: 1. Contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. 2. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8-inch blade to the depth indicated. C. Expansion Joints: 1. Expansion joints shall be formed with 3/8-inch joint filler strips. Joint filler shall be placed with top edge 1/4 inch below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. 2. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. 3. At the end of the curing period, expansion joints shall be carefully cleaned and filled with joint sealer. Concrete at the joint shall be surface dry and the atmospheric and pavement temperatures shall be above 50□ F at the time of application of joint-sealing materials. Joints shall be filled with sealer flush with the concrete surface in such manner as to minimize spilling on the walk surface. Spilled sealing material shall be removed immediately and the surface of the walk cleaned.

3.10 CURB AND GUTTER JOINTS

A. Curb and gutter joints shall be constructed at right angles to the line of curb and gutter. B. Contraction Joints: 1. Where applicable, contraction joints shall be constructed directly opposite contraction joints in abutting Portland cement concrete pavements and spaced so that monolithic sections

between curb returns will not be less than 5 feet nor greater than 15 feet in length. 2. Where curb and gutter does not abut Portland cement concrete pavement, contraction joints shall be spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. 3. Contraction joints shall be constructed by means of 1/8-inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing. C. Expansion Joints: 1. Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. 2. Where applicable, expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting Portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. 3. Where curb and gutter does not abut Portland cement concrete pavement, expansion joints at least 3/8 inch in width shall be provided at intervals not exceeding 100 feet. 4. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit.

3.11 CURING AND BACKFILLING

A. Curing: Immediately after the finishing operations, the exposed concrete surface shall be cured for 7 days by the mat, impervious sheet, or membrane-curing method. B. Backfilling: After curing, debris shall be removed and the areas adjoining shall be backfilled, graded and compacted to conform to the surrounding area in accordance with the lines and grades indicated.

3.12 PROTECTION

A. Beginning immediately after placement, protect concrete from mechanical injury. B. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing and curing. C. Repair damaged concrete and clean concrete discolored during construction. D. Work that is damaged shall be removed and reconstructed to the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable.

3.13 DISPOSAL

A. Transport debris and excess material from site and legally dispose of them.

END OF SECTION

SECTION 32 13 17
PAVEMENT MARKING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. Pavement marking in the types and arrangements shown.

1.03 RELATED SECTIONS

A. Section 32 13 13 – Portland Cement Concrete Pavement.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Division 1 Specifications. B. Product data: Within 60 calendar days after the Contractor has received the Owner's Notice to Proceed, submit: 1. Materials list of items proposed to be provided under this Section; 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements; 3. Photographs, scale drawings, or other data acceptable to the Engineer, showing types of graphics proposed to be used.

1.05 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.01 PAVEMENT MARKING PAINT

A. Provide paint specifically formulated for use as pavement marking in automobile traffic areas, and in the colors selected by the Engineer from standard colors of the approved manufacturer. B. Acceptable products: 1. "Traffic Marking Paint" manufactured by Sherwin Williams. 2. "Traffic Paint" manufactured by Aexcel. 3. "Traffic Paint" manufactured by US Specialty Coatings.

2.02 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

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

3.02 APPLICATION

A. Secure the Engineer's approval of graphics design and layout prior to start of application.

B. Using proper masking, stencils, and application equipment recommended for the purpose by the manufacturer of the approved paint, apply the approved paint in strict accordance with its manufacturer's recommendations.

3.03 PROTECTION

A. Provide traffic cones, barricades, and other devices needed to protect the paint until it is sufficiently dry to withstand traffic.

3.04 CLEANUP

A. When paint is thoroughly dry, visually inspect the entire application, and: 1. Touchup as required to provide clean, straight lines and surfaces throughout. 2. Using a permanently opaque paint identical in color to the surface on which the

paint was applied, block out and eliminate all traces of splashed, tracked, and/or spilled pavement marking paint from the background surfaces.

END OF SECTION

SECTION 32 13 18
TRAFFIC AND HANDICAP PARKING SIGNS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. Erect traffic signs. B. Erect handicap parking signs.

1.03 RELATED SECTIONS

A. Section 03 30 00 - Cast-In-Place Concrete.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Division 1 Specifications. B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit: 1. Materials list of items proposed to be provided under this Section; 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. B. Sign Fabricator: Five years experience in fabrication of traffic signs. C. Shop Fabrication: Fabricate signs in shop.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver signs to the site in manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, type, message, and related information. Store in a safe, dry, clean, and wall ventilated area, protected from damage, soiling, and moisture. Store packages flat. Do not open containers until needed for installation unless verification inspection is required.

PART 2 - PRODUCTS

2.01 SIGNS

A. Except where otherwise indicated or specified, all materials shall conform to ANSI D6.1. Unless otherwise shown, all signs shall be "standard" sizes as specified in ANSI D6.1. B. Sign Material: 1. Signs shall be constructed of 0.08-inch mill finish aluminum conforming to ASTM B 209, alloy 6061, T 6, degreased and etched. 2. The finish, except the reflective surfacing, shall be baked-enamel finish applied after fabrication. 3. Sign faces shall be fully reflectorized with material conforming to Federal Specification L- S-300, Type I, Class 2, Reflectivity No. 1. C. Handicap Symbol Sign and Parking Sign: 1. Parking sign faces shall have a green legend and border with white background.

2. Reserved Parking sign shall also have a white handicap symbol on a blue background and shall be similar to sign R7-8 in ANSI D6.1.

2.02 POSTS

A. Posts shall be round galvanized steel tubing and shall conform to the indicated details.

2.03 APPURTENANCES

A. Hardware: Bolts, nuts, washers, and clamps shall be stainless steel. Bolts shall be a minimum of 3/8-inch in diameter. B. Concrete: Concrete shall be 3,000 p.s.i. conforming to SECTION 03 30 00.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: 1. Except where otherwise indicated or specified, all work shall conform to ANSI D6.1. Signs of the type and size indicated shall be installed in locations shown on the drawings. 2. Do not install signs until final grading is completed, unless otherwise approved in writing. B. Excavation: Drill holes in firm, undisturbed, or compacted soil. 1. Remove loose

and foreign materials from sides and bottoms of footing holes. Moisten footing holes before placing concrete. C. Posts: 1. Set in 3,000 psi compressive strength concrete. 2. Center, align, plumb and brace in footing holes, with post bottoms elevated 3" above bottom of footing hole. Check posts for vertical and top alignment before pouring concrete. 3. Place concrete in continuous pour; vibrate or tamp for consolidation. 4. Allow concrete to thoroughly cure before erecting sign.

3.02 DISPOSAL

A. Transport debris and excess materials from site and legally dispose of it.

END OF SECTION

SECTION 32 92 00
TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: 1. Sodding. 2. Erosion-control material(s).

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

A. Architect approval is required. The following shall be provided:

1. Pesticide and Herbicide Treatment Plan, giving proposed sequence of pesticide and herbicide treatment work, before work is started. The pesticide and herbicide trade name, chemical composition, formulation, concentration, application rate of active ingredients and methods of application for all materials furnished, and the name and state license number of the state certified applicator shall be included.

2. Certificates of compliance certifying that materials meet the requirements specified, prior to the delivery of materials. Reports for the following materials shall be included:

a. Fertilizer: For chemical analysis and composition percent.\

b. Pesticide and Herbicide Material: For EPA registration number and registered uses.

3. Product Certificates: For fertilizers, from manufacturer.

1.4 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 Oklahoma Department of Transportation (ODOT), most recent edition.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

B. Bulk Materials: 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants. 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways. 3. Accompany each delivery of bulk materials with appropriate certificates.

1.6 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Turf grass shall be Bermuda sod. Sod shall be freshly cut (no more than 5 days). Water all areas to receive sod 1/4" less than 24 hours prior to installation of new sod. Sod all disturbed and exposed soil within the project limits as indicated on the Drawings.

B. Substitutions will not be permitted without written request from the Contractor for approval by the Architect.

C. Sod shall be grown under climatic conditions similar to those in the locality of the project.

2.2 PESTICIDES

A. 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 unless authorized in writing by the Authority.

B. 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.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.3 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.

B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

C. Erosion-Control Mats: Cellular, nonbiodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 4-inch nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.

2.4 Fertilizer:

A. The commercial grade of fertilizer shall be suitable for the locations and season approved by the Architect. The P-N-K content shall be determined on the basis of soil conditions and the plants involved.

B. Prepackaged fertilizer delivered to the site shall be packaged in new, sealed, clean containers which bear a label fully describing the contents, the chemical analysis of each nutrient, the fertilizer grade, the net bulk, and the brand name and address of the manufacturer. Bulk fertilizer delivered to the site shall be accompanied with certification describing the contents, the chemical analysis of each nutrient, the fertilizer grade, the net bulk, and the brand name and address of the manufacturer. No fertilizer which becomes caked or otherwise damaged will be accepted.

2.5 Water:

A. Water shall not contain elements toxic to plant life.

B. The Contractor is responsible for ensuring that new lawns are adequately watered at all times.

C. During prolonged periods of drought, watering guidelines established by local water district shall apply.

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. 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.

C. 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 Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to ODOT Specifications.

B. 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.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architects acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.

C. Fill cells of erosion-control mat with planting soil and compact before planting.

D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SODDING

A. Sodding shall comply with MDOT Specifications

3.6 TURF MAINTENANCE

A. General: 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. 1. 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. 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement. 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. 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 Authority. 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.

C. 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.

3.7 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Engineer: 1. Satisfactory Seeded Turf: 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. 2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.8 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 the Authority’s operations and others in proximity to the Work. Notify MHOG 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.

3.9 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 32 92 00

SECTION 33 41 00
STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. Storm drainage system. B. If building roof drains are not in place, terminate lines 5'-0" from building walls at locations shown on drawings.

1.03 RELATED SECTIONS

A. Section 31 2320 – Trenching and Backfilling for Utilities.

1.04 SUBMITTALS

A. Product Data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit: 1. Materials list of items proposed to be provided under this Section; 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements; 3. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. B. Codes, Ordinances: Specifications included herein are minimum; meet or exceed requirements and standard specifications of State, County, City or Township or other regulatory agencies under whose jurisdiction project is constructed.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage: 1. The inside of pipes and fittings shall be kept free of dirt and debris. 2. Gasket materials and plastic materials shall be protected from exposure to the direct sunlight over extended periods. B. Handling: Materials shall be handled in such a manner as to insure delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

1.07 PROJECT CONDITIONS

A. Coordination: Coordinate this work with the work of other Sections to avoid any delay or interference with other work.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

A. Provide pipe and associated materials of the size indicated on the Drawings and meeting the following requirements. B. Reinforced Concrete Pipe (RCP): 1. Provide Class III complying with ASTM C 76. 2. Use bell and spigot or tongue and groove joints. 3. When flexible joints are used:

a. Provide rubber type gaskets for bell and spigot or tongue and groove pipe, complying with ASTM C 443, but with shore durometer hardness type A, 40-55, in lieu of the hardness specified; or b. Provide plastic sealing compound for tongue-and-groove pipe. Design of joints and physical requirements for preformed plastic sealing compound shall conform to FS SS-S-210. 4. When flexible watertight joints are required, use rubber type gaskets as specified above. C. Polyvinyl Chloride Pipe and Fittings (PVC): 1. Comply with ASTM D 3034. 2. Use extra strength, minimum of SDR 35. 3. Elastomeric Gasket Joints: ASTM D 3212, Push-on Type. 4. Elastomeric Gaskets: ASTM F 477. D. High Density Polyethylene Pipe (HDPE): 1. Comply with AASHTO M252, Type “S” and M294, Type “S”. 2. Joints: Pipe shall be joined with the Sure-Lok (bell and spigot) joint meeting AASHTO M252 Type “S”, AASHTO M294 Type “S” or MP7-97. The joint shall be silt tight and leak resistant. Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477 with the addition that the gaskets shall not have any visible cracking. E. Polyethylene Material in Plastic Couplings: Comply with ASTM D 2952. F. Flexible Watertight Joints: 1. Joints within the building area, outside the building area but within ten

feet of exterior walls or faces of the buildings shall be flexible watertight joints. 2. Provide gasket with not more than one splice, except that two splices of rubber gasket type will be permitted if the nominal diameter of the gasket exceeds 54".

2.02 DRAINAGE STRUCTURES

A. General: 1. Construct manholes, inlets, and junction structures of reinforced concrete or precast reinforced concrete, complete with metal frames and covers or gratings as shown on the Drawings or required by codes. B. Concrete: Comply with provisions for 3,000 psi concrete. C. Mortar for pipe joints and connections to other drainage structures, and manhole construction: 1. Comply with requirements of ASTM C 270, type M, except the maximum placement time shall be one hour. 2. Hydrated lime complying with ASTM C 141, type B, may be added to the mixture of sand and cement in an amount equal to 25% of the volume of cement used. 3. Provide a quantity of water in the mixture sufficient to produce a stiff workable mortar, which shall be clean and free from harmful acids, alkalis, and organic impurities. Use the mortar within 30 minutes after water is added to the mix. D. Precast Reinforced Concrete Manholes: 1. Comply with ASTM C 478, precast rings and cone sections. 2. Provide O-ring joints with gaskets conforming to ASTM C 443. E. Frames and Covers or Gratings: 1. Provide all gratings or covers from the same manufacturer. 2. Provide standard black finish, supplied as a total unit, sized as shown on the Drawings or larger sizes except where in a pavement area, and with the wording "STORM DRAIN" cast into the cover. 3. Shape, size, and waterway openings for grates and inlets shall be as indicated on the plans. 4. Iron Castings: a. Conform to ASTM A 48. b. Provide castings which are free from warp and defects. 5. Steel Frames and Gratings: a. Material: Structural Steel, ASTM A 36.

b. Fabrication: Shop and field welding shall be arc welding and shall be done in accordance with the current specifications of AWS Structural Welding Code. c. Appurtenances: Bolts, nuts, and washers shall conform to AASHTO M 164. d. Steel frames and gratings shall be galvanized after fabrication in conformance with ASTM A 123. F. Precast Concrete Catch Basins: 1. Provide reinforced and bottom open for field pouring to ensure slope through the structure. 2. Contractor may select this option in lieu of cast-in-place concrete catch basins.

2.03 CLEANOUTS

A. Provide cleanouts as required and where shown on the Drawings. 1. Provide covers and frames, with the letter "SDCO" cast into the cover. 2. Provide traffic weight covers and frames where cleanouts are within pavement. 3. Provide light weight covers and frames where cleanouts are in graded, pedestrian or other non-traffic areas.

2.04 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

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

3.02 FIELD MEASUREMENTS

A. Make necessary measurements in the field to assure precise fit of items in accordance with the approved design.

3.03 EXCAVATING, TRENCHING, AND BEDDING

A. Excavate, trench, and bed for storm drains in accordance with pertinent provisions of Section 31 23 20, and the following. B. Movement of Construction Machinery: 1. Use means necessary to avoid displacement of, and injury to, pipe and structures while compacting by rolling or operating equipment parallel to the pipe. 2. Movement of construction machinery over a culvert or storm drain at any stage of construction is solely at the Contractor's risk.

3.04 INSTALLING PIPE

A. General: 1. Carefully examine each pipe prior to placing. a. Promptly set aside defective pipe and damaged pipe. b. Clearly identify defects. c. Do not install defective pipe or damaged pipe. 2. Place pipe to the grades and alignment indicated, unless otherwise directed by the Engineer. 3. Provide adequate facilities for lowering pipe safely into the trenches. 4. Do not place pipe in water, nor place pipe when trench or weather is unsuitable for such work. 5. Begin construction at outlet or low point of line. Do not begin construction of lateral lines until main or submain sewer has been completed to point where lateral line discharges into it. B. Concrete: Place by proceeding upgrade with the spigot ends of bell and spigot pipe, and the tongue ends of tongue and grove pipe, pointing in the direction of flow.

3.05 JOINTS

A. Concrete Pipe:

1. Wipe the inside of the joint clean and smooth. Perform wiping by dragging a suitable swab or long handled brush through the pipe as installation progresses. 2. Unless otherwise directed by Engineer, use cement mortar or flexible joints for bell and spigot pipe and flexible joints for tongue and groove pipe. 3. Cement Mortar Bell and Spigot Joints: a. Bed the first pipe to the established gradeline, with the bell end placed upstream. b. Use the specified mortar ingredients. c. Use the mortar within 60 minutes from the time water is first added to the mix. d. Clean surface of bell with wet brush, and fill lower portion with mortar to such depth as to bring the inner surfaces to the abutting pipes flush and even. e. Clean the spigot end of each subsequent pipe with a wet brush, and uniformly match the bell so that the sections are closely fitted. f. After laying each section, fill the remainder of joint with mortar, and form a bead around the outside of the joint with mortar. g. Use the specified mortar. If mortar can slump before setting, wrap or bandage the outside of the joint with cheesecloth to retain mortar in place. h. Protect the mortar bead on the outside from air and sun with suitable covering until cured. 4. Flexible Joints: a. Use the specified materials. Equal materials may be used when specifically approved in advance by the Engineer. b. Install gaskets and joint materials in accordance with the manufacturers' recommendations as approved by the Engineer. c. Use lubricants, primers, and adhesives recommended for the purpose by the pipe manufacturer. d. Protect from sun, blowing dust, and other deleterious agents at all times. e. Align the pipe with previously installed pipe, and pull the joint together. If, while making the joint, the gasket or jointing material becomes loose and can be seen through exterior joint recess when joint is pulled to within 1" of closure, remove pipe and remake the joint. f. Inspect gaskets, and replace loose and improperly affixed gaskets and jointing materials. B. PVC Pipe: 1. Cutting: a. Cut plastic pipe square. b. Protect against abrasion from serrated holding devices. c. Remove burrs and glosses from surfaces to be jointed; use abrasive paper, file, or steel wool. d. Remove dirt, dust, and moisture by wiping clean with chemical cleaner or dry cloth. 2. Joining: a. Using a pure bristle paint brush, apply an even coat of the specified solvent cement in the fitting socket and on the surface of the pipe to be joined. b. Promptly insert pipe into bottom of the fitting socket; turn the pipe slightly to assure an even distribution of cement. c. Remove excess solvent cement from exterior of the joint. d. Should cement begin to dry before the joint is made, reapply cement before assembling. e. Allow at least one hour for the joint to gain strength before handling or installing the pipe. f. Do not thread plastic pipe; make connections only with the solvent cement or with special adapter fittings designed for the purpose. 3. Align pipe system components without strain. C. Joining Pipe of Different Materials: 1. Provide fittings or couplings made for pipe material jointing, or provide a concrete collar as approved by the Engineer. D. Joining Pipe or Different Sizes: 1. Provide reducer fittings to the larger pipe.

2. Where pipes are different materials as well as different sizes, use the same material for reducer fitting as in the larger pipe. 3. Use saddle connection when branch lines join a main or collector main. 4. Use eccentric collar joint when the slope of the pipe is less than 1%.

3.06 DRAINAGE STRUCTURES

A. Install drainage structures in accordance with the Drawings and with manufacturers' recommendation as approved by the Engineer. B. Jointing and Plastering: 1. Completely fill mortar joints, and leave smooth and free from surplus mortar on the inside of the drainage structure. C. Manhole Frames and Covers: Unless otherwise shown on the Drawings, set frames and covers: 1. In Paved Areas: So that the top of the cover will be flush with the finished pavement; or 2. In Unpaved Areas: 2" higher than finished grade.

3.07 BACKFILLING

A. Backfill and compact in accordance with pertinent provisions of Section 31 23 20.

3.08 BUILDING CONNECTION

A. Terminate building connections where shown on the Drawings. B. Provide temporary closures at terminals where the building pipe is not installed. 1. Place marker post at grade end of plugged line. 2. Where building piping has been installed, make connection to the building piping system.

3.09 TESTING AND INSPECTING

A. Provide personnel and equipment necessary, and perform tests required to demonstrate that the work of the Section has been completed in accordance with the specified requirement. B. Hydrostatic Test on Watertight Joints: 1. Make a hydrostatic test on each watertight joint. Test one sample of each type watertight joint used. If one sample fails because of faulty workmanship, test an additional joint. 2. Demonstrate that joints in reinforced and unreinforced concrete pipe

comply with ASTM C 443. 3. Comply with ASTM C 425 for tests of joints in clay pipe. 4. Make tests in pipe at an internal hydrostatic pressure of 10 psi for 24 hours. 5. Only joints within the building area and outside the building area but within ten feet of exterior walls or faces of the buildings need be tested. 6. Replace or repair joints found to be faulty. Repeat the test and repair cycle until joints are demonstrated to meet the specified requirements.

END OF SECTION

SECTION 33 41 01
WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. Water distribution system. B. Where building lines are not in place, terminate lines at points 5-ft. from building walls, as indicated on drawings or as directed, and close lines with approved plugs or caps.

1.03 RELATED SECTIONS

A. Section 31 23 20 – Trenching and Backfilling for Utilities.

1.04 CONNECTION TO PUBLIC WATER SYSTEM

A. Make arrangements for connecting the on-site water line to the public water system. B. Pay all meter fees and other costs related to connection to the public water system. C. Provide materials as required by the utility owner for the size of connection being made. D. Comply with utility owner requirements for making connection, including making arrangements for work done by utility forces.

1.05 SUBMITTALS

A. Comply with pertinent provisions of Division 1 Specifications. B. Product Data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit: 1. Materials list of items proposed to be provided under this Section; 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements; 3. Names and addresses of the nearest service and maintenance organization that readily stocks repair parts; 4. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.06 QUALITY ASSURANCE

A. . Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. B. Codes and Ordinances: Specifications included herein are minimum; meet or exceed requirements and standard specifications of state, county, city or township under whose jurisdiction project is constructed. Specifically, for water mains dedicated to the utility owner, comply with the specifications and standard details of the utility owner. C. Coordination: Contact utility companies serving project and coordinate connecting-up in compliance with their requirements. In certain instances, utility companies will furnish certain piping; however, Contractor is responsible for providing materials and work not provided by utility companies.

1.07 PROJECT CONDITIONS

A. Coordination: Coordinate this work with the work of other Sections to avoid any delay or

interference with other work. B. Bonds: All surety bonds for performance and maintenance bonds required by local regulatory agencies shall be provided by the Contractor at no additional cost to Owner.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. General: 1. Assume connection point to building service lines as being approximately five feet outside buildings and structures to which service is required. 2. Pipe Materials 3" Size and Larger: Use ductile iron or plastic pipes unless otherwise indicated or approved in advance by the Engineer. 3. Pipe Materials Smaller Than 3" Size: Use plastic pipes. B. Pipe: 1. Ductile Iron Pipe: a. Comply with AWWA C 151, with working pressure of not less than 250 psi unless otherwise shown or specified. b. Use cement mortar lining complying with AWWA C 104, standard thickness. 2. Plastic Pipe, 3" Size and Larger: PVC pipe, AWWA C 900 Class 200, Cast-Iron O.D. pipe dimensions, elastomeric-gasket joint. 3. Plastic Pipe, Smaller Than 3" Size: a. Use acrylonitrile-butadine-styrene (ABS) complying with ASTM D 15527; or b. Use polyvinyl-chloride (PVC) complying with ASTM D 1785, Schedule 40. C. Joints: 1. Ductile Iron Pipe: a. Use mechanical joints or

push-on joints complying with AWWA C 111. b. Use rubber gaskets and lubricant complying with applicable requirements of AWWA C 111. 2. Plastic Pipe, 3" Size and Greater: Elastomeric-gasket joints in accordance with pipe manufacturer's recommendations and ASTM F 477. 3. Plastic Pipe, Smaller Than 3" Size: a. Use solvent cement for PVC joints complying with ASTM D 2564. b. Use solvent cement for ABS joints complying with ASTM D 2235: D. Fittings and Specials: 1. Ductile Iron Pipe and Plastic Pipe, 3" Size and Larger: a. Use fittings and specials suitable for 250 psi pressure rating unless otherwise specified. b. Use mechanical joint fittings complying with AWWA C 110 or C 153, with joints complying with AWWA C 111. c. Use cement mortar lining complying with ANSI A 21.4, standard thickness. 2. Plastic Pipe, Smaller Than 3" Size: a. Use fittings and specials suitable for Schedule 40 rating, unless otherwise specified or directed. b. Use fittings and specials for PVC pipe complying with ASTM D 2468. c. For threaded PVC fittings, use Schedule 80. E. Gate Valves: 1. Use gate valves designed for a working pressure of not less than 150 psi. 2. Provide connections as required for the piping in which they are installed. 3. Provide a clear waterway equal to the full nominal diameter of the valve, openable by turning counter clockwise. 4. Provide an arrow on the operating nut or wheel, cast in metal, indicating direction of opening. 5. Valves Smaller Than 3": a. Provide all bronze, screwed, single wedge disc, screw-in bonnet, packing gland, and

nut, with non-rising stem. b. Buried Valves: Install in suitable precast concrete hand hole with cover marked "WATER." 6. Valves 3" and Larger: a. Design in accordance with AWWA C 500, standard, bronze trimmed, non-rising stem, solid wedge disc valves; or b. Design in accordance with AWWA C 509, resilient-seated gate valves. c. Buried Valves: Provide 2" operating nuts and in a suitable valve box with extension and marked cover. d. Provide tee handle socket operating wrenches of suitable size. F. Check Valves: 1. Use check valves designed for a working pressure of not less than 150 psi, or as indicated or directed, with a clear waterway equal to the full nominal diameter of the valve. 2. Use valves designed to permit flow in one direction, when the inlet pressure is greater than the discharge pressure, and to close tightly to prevent return flow when discharge pressure exceeds inlet pressure. 3. Distinctly cast on the body of each valve: a. Manufacturer's name, initials, or trademark by which he can be identified readily; b. Valve size; c. Working pressure; d. Direction of flow. 4. Valves 2" and Smaller: Provide all bronze, designed for screwed fittings. 5. Valves Larger Than 2": a. Provide iron body, bronze mounted, with flanged ends, of the non-slam type; b. Provide class 125 flanges complying with ANSI B 16.1. G. Service Fittings: 1. PVC Mains Smaller Than 2" in Diameter: a. Make 3/4" maximum service with tees or plastic valve tees. 2. PVC Mains 2" to 3½" in Diameter: For ¾" service to 1" service, use bronze corporation stop designed for PVC pipe. 3. Service Clamps and Corporation Stops: a. Use bronze. b. Provide service clamp with flattened straps and molded neoprene gaskets. 4. Services Larger Than Those Stated Above: Make with standard tees on new lines, and tapping tees on existing lines.

2.02 TAPPING SLEEVES

A. Provide sleeve type coupling for existing water mains, furnished with outlet flanged to American 125 standard (ASA series 15): B. Acceptable Products: 1. Clow Corporation, Corona, California; boltless type: a. Model C1 series for existing cast iron mains, complying with AWWA class A; b. Model CA for class 150 and class 200 existing asbestos cement mains; c. Or equal, as approved by the Engineer. C. Coordinate requirements of tapping sleeves with gate valves and other fittings as required.

2.03 VALVE BOXES

A. Valves 3" and Larger: 1. Use service box of cast iron, extension type of the required length, with screw adjustment. 2. Provide the word "WATER" cast into the cover. B. Valves 2½" and Smaller: 1. Use precast concrete box with the word "WATER" cast into the cover.

2. Provide risers on pipe line to place valve within box depth.

2.04 POST INDICATOR VALVES

A. Valves: 1. Post indicator valves shall be from the same manufacturer as the buried gate valves and identical to and interchangeable with buried gate valves of the same size by simply changing the stuffing box. 2. The indicator post flange/"O" ring stuffing box combination shall be a separate part from the bonnet and shall be easily removed and replaced should the need occur. 3. Post indicator valves shall be UL/FM approved. B. Indicator Posts: 1. Indicator posts shall attach to the indicator post flange on the buried post indicator valves and provide a means to operate the buried valve and also indicate whether the valve is open or closed. 2. Working parts shall be protected from the weather. 3. Indicator posts shall have a lubrication point so that the bearing surfaces can be oiled. 4. An operating wrench and a means to connect it to the indicator post shall be provided. 5. Indicator posts shall be furnished in a length suitable for the depth of bury for each installation. 6. Indicator posts shall be UL/FM approved.

2.05 OTHER MATERIALS

A. Fire Hydrants: utility owner standard dry-barrel type conforming to AWWA C 502. 1. Hydrants shall be painted with one coat of red iron oxide, zinc-oxide primer conforming to SSPC-Paint 25 and two finish coats of silicone alkyd paint conforming to SSPC-Paint 21, of the color directed by the utility owner. 2. Hydrants shall be supplied with Fire Department standard hose connection sizes and threads. 3. Hydrants shall be supplied with Fire Department standard operating nut. 4. Hydrants shall be UL/FM approved. B. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

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

3.02 FIELD MEASUREMENT

A. Make necessary measurements in the field to assure precise fit of items in accordance with the approved design.

3.03 HANDLING

A. Handle pipe accessories so as to ensure delivery to the trench in sound, undamaged condition: 1. Carry pipe into position; do not drag. 2. Use pinch bars or tongs for aligning or turning the pipe only on the bare end of the pipe. B. Thoroughly clean interior of pipe and accessories before lowering pipe into trench. Keep clean during laying operations by plugging or other method approved by the Engineer. C. Before installation, inspect each piece of pipe and each fitting for defects: 1. Material found to be defective before or after laying: Replace with sound material meeting the specified requirements, and without additional cost to the Owner.

D. Rubber Gaskets: Store in a cool dark place until just prior to time of installation.

3.04 PIPE CUTTING

A. Cut pipe neatly and without damage to the pipe. B. Unless otherwise recommended by the pipe manufacturer, and authorized by the Engineer, cut pipe with mechanical cutter only. 1. Use wheel cutters when practicable. 2. Cut plastic pipe square, and remove all burrs.

3.05 LOCATING

A. Locate water pipe at least ten feet away, horizontally, from sewer pipes. B. Where water line crosses sanitary sewer, center one 20 ft. length of water pipe at the crossing. C. Where water lines cross under or less than 24" above gravity-flow sewer lines, fully encase the sewer pipe in concrete for a distance of at least ten feet each side of the crossing, or construct sewer line or pressure pipe with no joint located within 36" of the crossing D. Cross water lines in cases above sewage force mains or inverted siphons at least 24" above the sewer line. Encase in concrete those joints in the sewer main closer, horizontally, than 36" to the crossing. E. Do not place water lines in the same trench with sewer lines or electric wiring. F. Do not install copper tubing in trenches with ferrous piping materials. If copper tubing crosses ferrous piping, provide 12" minimum separation between pipes.

3.06 JOINT DEFLECTION

A. Ductile Iron Pipe: Do not exceed maximum allowable deflection given in AWWA C 600. B. Plastic Pipe: Unless a lesser amount is recommended by the pipe manufacturer, maximum allowable deflections from a straight line or grade, or offsets, will be five degrees.

3.07 PLACING AND LAYING

A. General: 1. Trench, backfill, and compact for the work of this Section in strict accordance with pertinent provisions of Section 31 23 20 of these Specifications. 2. Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment approved by the Engineer. 3. Do not dump or drop any of the materials of this Section into the trench. 4. Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying. 5. Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, coupling, and joints. 6. Take up and relay pipe that has the grade or joint disturbed after laying. 7. Do not lay pipe in water, or when trench conditions are unsuitable for the work; keep water out of the trench until jointing is completed. 8. Securely close open ends of pipe, fittings, and valves when work is not in progress. 9. Where any part of coating or lining is damaged, repair to the approval of the Engineer and at no additional cost to the Owner. B. Plastic Pipe: 1. Position pipe

and fittings in trench in a manner that identifying markings will be readily visible for inspection. 2. Cutting: a. Protect against abrasion from serrated holding devices. b. Remove burrs and glosses from surfaces to be jointed; use abrasive paper, file, or steel wool.

c. Remove dirt, dust, and moisture by wiping clean with chemical cleaner or dry cloth. 3. Joining Less Than 3" Size: a. Using a pure bristle paint brush, apply an even coat of the specified solvent cement in the fitting socket and on the surface of the pipe to be joined. b. Promptly insert pipe into bottom of the fitting socket; turn the pipe slightly to assure an even distribution of cement. c. Remove excess solvent cement from exterior of the joint. d. Should cement begin to dry before the joint is made, reapply cement before assembling. e. Allow at least one hour for the joint to gain strength before handling or installing the pipe. f. Do not thread plastic pipe; make connections only with the solvent cement or with special adapter fittings designed for the purpose. 4. Align pipe system components without strain. 5. Provide an electrically continuous type TW insulated number 14 tracer wire in the trench along the pipe, fastened to the pipe at 20 foot intervals, and terminating aboveground with a 12" lead taped around each riser. C. Connections: Use specials and fittings to suit the actual conditions where connections are made between new work and existing mains. Use only those specials and fittings approved by the utility having jurisdiction. D. Sleeves: 1. Where pipe passes through walls of valve pits or structures, provide cast iron wall sleeves. 2. Fill annular space between walls and sleeves with rich cement mortar. 3. Fill annular space between pipe and sleeves with mastic.

3.08 JOINTING

A. Ductile Iron Pipe: Install mechanical joints and push-on type joints in accordance with AWWA C 600, modified as necessary by the recommendation of the manufacturer to provide for special requirements of ductile iron pipe. B. Plastic Pipe, 3" Size and Greater: PVC pipe shall be installed in accordance with pipe manufacturer's recommendations and AWWA M 23. C. Make connections between different types of pipe and accessories with transition fittings. D. Rubber Gaskets: Handle, lubricate where necessary, and install in strict accordance with the recommendations of the manufacturer.

3.09 SETTING VALVES AND VALVE BOXES

A. General: 1. Center valve boxes on the valves, setting plumb. 2. Tamp backfill around each valve box to a distance of four feet on all sides, or to the undisturbed trench face if less than four feet. 3. Tighten stuffing boxes, and fully open and close each valve to assure that all parts are in working condition. B. Service Boxes: 1. Where water lines are located below paved streets having curbs, install boxes directly back of the curbs. 2. Where no curbing exists, install boxes in accessible locations beyond limits of street surfacing, walks, and driveways.

3.10 APPURTENANCES

A. Meter and Meter Box: Set meter and meter box in conformance with the requirements of the City. B. Fire Hydrant: Set fire hydrant in conformance with the requirements of the City.

3.11 THRUST BLOCKS

A. General: 1. Provide thrust blocks, or metal tie rods and clamps or lugs, on plugs, caps, tees, and bends deflecting 11-¼□ or more either vertically or horizontally, and on water lines 4" in diameter or larger. 2. Provide concrete thrust blocking with a compressive strength of 2,500 psi in 28 days. B. Installation: 1. Locate thrust blocking between solid ground and the fitting to be anchored. 2. Unless otherwise shown or directed by Engineer, place the base and thrust bearing sides of thrust blocking directly against undisturbed earth. 3. Sides of thrust blocking not subject to thrust may be placed against forms. 4. Place thrust blocking so the fitting joints will be accessible for repair. 5. Protect steel rods and clamps by galvanizing or by coating with bituminous paint.

3.12 TESTING AND INSPECTING

A. Closing Uninspected Work: Do not allow or cause any of the work of this Section to be covered up or enclosed until after it has been completely inspected and tested, and has been approved by the Engineer. B. Hydrostatic Tests: 1. Where any section of a water line is provided with concrete thrust blocking for fittings, do not make hydrostatic tests until at least five days after installation of the concrete thrust blocking, unless otherwise directed by the Engineer. 2. Devise a method for disposal of waste water from hydrostatic test, and for disinfection, as approved in advance by the Engineer. C. Pressure Tests: 1. After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, subject the newly laid piping and valved sections of water distribution and service piping to a hydrostatic pressure of 200 psi. 2. Open and close each valve several times during the test. 3. Carefully examine exposed pipe, joints, fittings, and valves. 4. Replace or remake joints showing visible leakage.

5. Remove cracked pipe, defective pipe, and cracked or defective joints, fittings, and valves. Replace with sound material and repeat the test until results are satisfactory. 6. Make repair and replacement without additional cost to the Owner. D. Leakage Test: 1. Conduct leakage test after the pressure test has been completed satisfactorily. 2. Duration of each leakage test: At least two hours. 3. During the test, subject water lines to a pressure of 200 psi. 4. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. 5. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by formula, "L = 0.00027 x N x D x sq root of P," where: L = allowable leakage in gallons per hour; N = number of joints in length of pipe under test; D = nominal diameter of pipe in inches; and P = average test pressure in lbs per sq inch. 6. Should any test of pipe disclose leakage greater than that specified, locate and repair the defective joint or joints until the leakage is within the specified allowance, and at no additional cost to the Owner.

E. Time for Making Test: 1. Except for joint material setting, or where concrete reaction backing necessitates a five day delay, pipelines jointed with rubber gaskets, mechanical, or push-on joints, or couplings may be subjected to hydrostatic pressures, inspected, and tested for leakage at any time after partial completion of backfill. F. Disinfection: 1. Before acceptance of the potable water system, disinfect each unit of completed water supply, distribution, and service line in accordance with AWWA C 601. 2. Perform all such tests and disinfection in a manner approved by governmental agencies having jurisdiction. 3. All fees to cover the cost of bacteriological tests shall be paid by the Contractor. 4. If such samples do not demonstrate satisfactory results, chlorination will be repeated. 5. Furnish two copies of a Certificate of Disinfection to the Engineer.

END OF SECTION

SECTION 33 41 02
GAS DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. Gas distribution system.

1.03 RELATED SECTIONS

A. Section 31 23 20 – Trenching and Backfilling for Utilities.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Division 1 Specifications. B. Product Data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit: 1. Materials list of items proposed to be provided under this Section; 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements; 3. Names and addresses of the nearest service and maintenance organization that readily stocks repair parts; 4. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.05 QUALITY ASSURANCE

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

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

A. Gas Distribution Main: 1. Use polyethylene pipe (PE) underground and black steel pipe aboveground, as permitted by the utility company and other agencies having jurisdiction and as selected by the Contractor. 2. Where matching or joining existing mains, use the material being matched or joined unless otherwise specifically approved by the Engineer. B. Gas Service Lines: 1. Use same material used for gas distribution main. 2. Assume connection point to building service lines as being approximately five feet outside buildings and structures to which service is required. C. Above Ground, Use: 1. Pipe: Black steel complying with ASTM A 120, Schedule 40; threaded ends on 2" and smaller, otherwise plain end beveled for butt welding. 2. Fittings: Black malleable iron complying with ANSI B-16.3. 3. Unions: Black malleable iron complying with Fed Spec WW-U-531. 4. Flanges: Black steel slip-on welding. 5. Gaskets: Neoprene, 1/16" thickness, 50 to 60 shore "A" hardness. 6. Fasteners: Cadmium plated steel nuts, bolts, and washers.

D. For Buried PE Systems: 1. Comply with ASTM D 2513 with pipe and fittings compounded in accordance with ASTM D 1248, type and grade as recommended by the manufacturer for natural gas installation. 2. Pipe: a. Comply with ASTM D 2239, SDR 11.5, 77 psi, for pipes up to 4" diameter. b. Greater wall thicknesses (smaller SDR number) are acceptable. 3. Fittings: Comply with ASTM D 2683, except that size 2" and larger may be butt fused, and fusion saddles with protective sleeves may be used for lines when branch is two or more pipe sizes smaller than size of main. 4. Gaskets: Neoprene, 1/8" thickness, 50 to 60 shore "A" hardness. 5. Fasteners: Monel nuts, bolts, and washers E. Risers for PE Systems: 1. Use red brass pipe complying with ASTM B 42 with brazed bronze flange complying with ANSI B-16.24., and inside plastic coating or liner. 2. For sizes larger than 2-½", provide threaded ends aboveground. 3. For PE Systems: a. Use only a manufacturer's standard transition fitting consisting of steel nipple bonded to PE coupling with copper sleeve pressed over the PE coupling. b. Extend the copper sleeve at least 2" above finish grade. c. Provide manufacturer-applied corrosion resistant enamel on exterior steel surfaces. F. Transition Fittings to Existing Pipe Line or Service Branch: 1. Provide monel bolts, nuts, and washers. 2. Steel-to-plastic, PE: a. Use flanged fitting complying with ANSI B-16.5, 150 lb; or b. Use transition fittings as specified for risers except designed for steel-to-plastic with a tapping tee. 3. Plastic-to-Plastic, PE-to-PE: a. Use manufacturer's standard fused tapping tee assembly with shut-off feature.

2.02 BURIED SHUT-OFF VALVES

A. Provide ball valves designed for close-off pressure in either direction: 1. Body and End Connection: Use gray or ductile cast iron, ANSI flanged ends or flangeless short pattern or configuration for installation between two 150 lb ANSI flanges. 2. Ball: Stainless steel, chromium plated shell, or chromium plate ductile iron. 3. Stems, Nuts, Bolts, and Washers: Monel, except stem may be type 316 stainless steel. 4. Seal and Stem Seals: Glass reinforced TFE (Teflon). 5. Handle: For each series of valves requiring a common wrench provide two valve wrenches.

2.03 ABOVEGROUND VALVES

A. For shut-off valves size 2" and smaller, provide either: 1. Bronze body ball valve complying with Fed Spec WW-V-35, Type I, Class A, Style 3, full port pattern, with reinforced teflon seals and threaded ends; or 2. Bronze body plug valve, straightway, taper plug, regular pattern with port opening at least equal to the internal pipe area or round port full bore pattern, non-lubricated, teflon packing, flat or square-head stem with lever operator, 325 psig WOG rating, and threaded ends.

2.04 VALVE BOXES

A. Provide and place service box of cast iron or precast concrete over valves. Do not locate valve boxes in concrete walks. B. Valves 2-½" and Smaller: 1. Use precast concrete valve box with the wording "GAS" cast into the cover. 2. Provide risers on pipe line to place valve within the box depth.

C. Valves 3" and larger: 1. Use service box of cast iron, extension type of the required length, having screw adjustment. 2. Provide cast iron cover with the wording "GAS" cast into the cover.

2.05 TRACER WIRE

A. Provide No. 14 TW insulated copper tracer wire on non-metallic pipes.

2.06 CASING

A. Where gas lines are below concrete pavement, provide galvanized pipe complying with ASTM A 120, Schedule 40, with extruded polyethylene coating, in pipe sizes 2 sizes larger than the gas line.

2.07 WARNING TAPE FOR BURIED GAS LINES

A. Provide polyethylene plastic tape manufactured specifically for warning and identification of buried utility lines: 1. Roll type, 6" minimum width, color coded for natural gas (orange), with warning and identification imprinted in bold black letters continuously and repeatedly over entire length of tape. 2. Code and Lettering Color: Permanent, unaffected by moisture and other substances contained in trench backfill materials. 3. Message: "CAUTION, BURIED GAS LINE BELOW" or similar message as approved by the Engineer.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

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

3.02 FIELD MEASUREMENT

A. Make necessary measurements in the field to assure precise fit of items in accordance with the approved design.

3.03 INSTALLATION

A. Install pipe fittings in accordance with ANSI B-31.8, the Drawings, and as specified herein. B. Excavating and Backfilling: 1. Comply with pertinent provisions of Section 31 23 20. 2. Coordinate provision of utility warning and identification tape with backfill operations: a. Provide the specified tape above all buried gas lines at a depth of 8" to 12" below finished grade. C. Plastic Pipe and Fittings: 1. Handle pipe and fittings carefully. 2. Discard plastic pipe and fittings that have been dented or damaged. D. Pipe Cleaning: 1. Thoroughly clean inside of pipe and fittings before installing. 2. Blow line clear by using 80 psig to 100 psig clean dry compressed air. 3. Rap steel lines sharply along entire length before blowing clear. 4. Cap or plug ends of pipe as necessary to maintain cleanliness throughout installation. E. Aboveground Steel Lines: 1. Determine and establish measurements for piping at the job site. 2. Cut pipe accurately to determined length requirements. 3. Threaded Joints: a. Use threaded joints for pipe of 2" size and smaller.

b. Where possible, use pipe with factory-cut threads; otherwise cut pipe ends square, remove all fins and burrs, and cut taper pipe threads in accordance with ANSI B-2.1. c. Make threads smooth, clean, and full cut. d. Apply joint compound to male joints only. e. Work piping into place without springing or forcing. f. Do not back-off joints to permit alignment. g.

Engage threads so that not more that three threads remain exposed. h. Use unions for connections to valves for which no other means of disconnecting is provided. 4. Welded Joints: a. Use welded joints for pipe in sizes larger than 2". b. Weld by the shielded metal-arc process, using covered electrodes and in accordance with procedures established and qualified in accordance with ANSI B-31.8. c. Qualify each welder and welder operator in accordance with ANSI procedures: 1) Provide required tests; 2) Upon request of the Engineer, display certificates complying with ANSI B-31.8. 5. Flanged Joints: a. Use flanged joints for connecting welded joint pipe and fittings to valves to provide for disconnection. b. Install joints so that flange faces bear uniformly on gaskets. c. Engage bolts so that there is complete threading through the nuts, and tighten so that bolts are uniformly stressed and equally torqued. 6. Valves: a. Install shut-off valves with stems either in the vertical position with operators (lever or handwheel) on top, or in the horizontal position. b. Install pressure reducing valves with outlet pressure adjustment on top. 7. Pipe Size Changes: a. Use reducing fittings for changes in pipe size. b. Do not make size changes with bushings. 8. Painting: a. Paint ferrous metal piping, including supports, in accordance with the provisions of

b. Do not apply paint until piping tests have been completed. c. Upon completion of painting, identify piping in accordance with MIL-STD-101, except use commercially manufactured piping identification tape and decals in lieu of stencils and paint. F. Buried Plastic Lines: 1. Install in accordance with the manufacturers' recommendations as approved by the Engineer. 2. PE Piping: a. Prior to installation, demonstrate to the Engineer that the installing personnel are thoroughly qualified by experience and training for installation of PE gas distribution piping. b. For fittings, saddles, and butt connections, use the specified materials; for all other branch connections, provide protective sleeves as recommended by the pipe manufacturer and approved by the Engineer. c. Fusion weld joints, except where transitions are approved. d. Use electrically heated tools, thermostatically controlled, with an indicating thermometer. 3. Tracer Wire: a. Place parallel to pipe; tape to pipe at least every 20 feet. b. Terminate wires at gas terminals by taping the wire to riser 6" above grade.

c. Mechanically bond the wire ends together; wrap bare wire with plastic tape. 4. Plastic Pipe Installation: a. Bury pipe 24" below finish grade, or deeper where indicated. 5. Sand Cushion: a. Provide sand cushion in accordance with pertinent provisions of Section 31 23 20. G. Wrapping: 1. Where connection to existing lines is made underground, wrap all new steel transition fittings and all exposed existing pipe having damaged coating. 2. Clean pipe to bare metal. 3. Use 1-mil minimum thickness polyethylene tape. 4. Initially stretch tape to conform to the surface while spirally half-lapping. 5. Apply a second layer, half-lapped and spiraled as above, but with spirals perpendicular to first wrapping.

3.04 CONNECTION

A. Make connection to utility company or agency service line or meter in accordance with the requirements of the utility having jurisdiction.

3.05 FIELD INSPECTIONS AND TESTS

A. Metal Welding or Brazing Inspection: 1. Inspect for compliance with ANSI B-31.8. 2. Replace or repair defective welds, and retest until compliance. B. PE Fusion Welding Inspection: 1. Visually inspect butt-fusion welds by comparing with manufacturer's visual joint appearance chart. 2. Inspect other joints for proper fused connection. 3. Replace unsatisfactory joints by cutting out defective joint or replacing fittings. 4. Inspect 100% of joints; reinspect for corrections. 5. For initial inspections, secure assistance of authorized representative of the pipe manufacturer. C. Pressure Tests: 1. Test Pressure: 1-½ times working pressure, but in no case less than 50 psig. 2. Do not test until last solvent welded joint has set and cured at least 24 hours at temperatures above 70□ F. 3. Perform testing before backfilling. However, place sufficient backfill material between fittings to hold pipe in place during tests. 4. Test system gas tight in accordance with ANSI B-31.8. a. Use clean dry air for testing. Purge if required prior to testing. b. Make tests on entire system or on sections which can be isolated by valves. c. After pressurization, isolate entire piping system from all sources of air during test period. d. Maintain test pressure for at least 8 hours between times of first and last reading of pressure and temperature. e. Do not take test readings during rapid weather changes. f. Verify that ambient temperature is same as actual trench temperature. Do not permit reduction in applied test pressure other than that due to a change in ambient temperature. g. Allow for ambient temperature change in accordance with the relationship: P + 14.7 = (Pl + 14.7) (T2 + 460) / (Tl + 460), in which "T" and "P" represent Fahrenheit temperature and gage pressure respectively, "P1" and "P2" denote initial and final readings, and "P" is the calculated final pressure. If P exceeds the measured final pressure (final gage reading) by 1/2 psi or more: isolate sections of the piping system,

retest each section individually, and apply a solution of warm soapy water to joints to each section for which a reduction in pressure occurs after allowing for ambient temperature change. h. Repair leaking joints and repeat test until no reduction

in pressure occurs. i. Use a test gage calibrated in 1 psi increments and readable to 1/2 psi. D. System Purging: 1. After pressure tests, and before testing a gas contaminated line, purge the line with nitrogen at junction with main line to remove all air and gas. 2. Clear the completed line by attaching a test pilot fixture at capped stub-in line at building location, and let gas flow until test pilot ignites. 3. Use procedures complying with ANSI B-31.8.

END OF SECTION

SECTION 33 41 03
SANITARY SEWERAGE SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions, Supplementary Conditions, and applicable Standard Specifications, apply to this Section.

1.02 SECTION INCLUDES

A. Sanitary sewerage system. B. If building sewers are not in place, terminate lines 5'-0" from building walls at locations shown on drawings.

1.03 RELATED SECTIONS

A. Section 31 23 20 – Trenching and Backfilling for Utilities. B. Section 03 30 00 – Concrete Work.

1.04 CONNECTION TO PUBLIC SEWER SYSTEM

A. Make arrangements for connecting the on-site sewer line to the public sewer system. B. Pay all tap fees and other costs related to connection to the public sewer system. C. Provide materials as required by the utility owner for the size of connection being made. D. Comply with utility owner requirements for making connection, including making arrangements for work done by utility forces.

1.05 SUBMITTALS

A. Comply with pertinent provisions of Division 1 Specifications. B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit: 1. Materials list of items proposed to be provided under this Section; 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements; 3. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.06 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. B. Codes, Ordinances: Specifications included herein are minimum; meet or exceed requirements and standard specifications of State, County, City or Township or other regulatory agencies under whose jurisdiction project is constructed.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Storage: 1. The inside of pipes and fittings shall be kept free of dirt and debris. 2. Gasket materials and plastic materials shall be protected from exposure to the direct sunlight over extended periods. B. Handling: Materials shall be handled in such a manner as to insure delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

1.08 PROJECT CONDITIONS

A. Coordination: Coordinate this work with the work of other Sections to avoid any delay or

interference with other work. B. Bonds: All surety bonds for performance and maintenance bonds required by local regulatory agencies shall be provided by the Contractor at no additional cost to Owner.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Polyvinyl Chloride Pipe Solid Wall Pipe and Fittings (PVC) Green Pipe for Sanitary Sewer and Storm Sewer: 1. Comply with ASTM D 1785 and ASTM D 2665. 2. Use PVC Plastic Pipe, Schedule 40. 3. Elastomeric Gasket Joints: ASTM D 3212, Push-on Type. 4. Elastomeric Gaskets: ASTM F 477. B. Polyvinyl Chloride Pipe and Fittings (PVC) SDR 35: 1. Comply with ASTM D 3034. 2. Use extra strength, minimum of SDR 35. 3. Elastomeric Gasket Joints: ASTM D 3212, Push-on Type. 5. Elastomeric Gaskets: ASTM F 477.

2.02 MANHOLES

A. Precast: 1. Provide reinforced precast concrete manhole sections complying with ASTM C 478. 2. Provide O-ring joints with gaskets conforming to ASTM C 443. 3. Provide precast units of concrete rings and eccentric cone section. B. Concrete: Provide 3,000 psi concrete in accordance with pertinent provisions of Section 03 30 00 of these Specifications. C. Mortar: 1. Comply with requirements of ASTM C 270, type M, except the maximum placement time shall be one hour. 2. Hydrated lime complying with ASTM C 141, type B, may be added to the mixture of sand and cement in an amount equal to 25% of the volume of cement used. 3. Provide a quantity of water in the mixture sufficient to produce a stiff workable mortar, which shall be clean and free from harmful acids, alkalis, and organic impurities. Use the mortar within 30 minutes after water is added to the mix.

2.03 FRAMES AND COVERS

A. Use cast iron frames and covers, with the wording "SEWER" cast into the covers in letters 2" high and plainly visible. 1. Conform to ASTM A 48. 2. Provide castings which are free from warp and defects.

2.04 CLEANOUTS

A. Provide cleanouts as required and where shown on the Drawings. 1. Provide covers and frames, with the letter "SSCO" cast into the cover. 2. Provide traffic weight covers and frames where cleanouts are within pavement. 3. Provide light weight covers and frames where cleanouts are in graded, pedestrian, or other non-traffic areas.

2.05 OTHER MATERIALS

A. Manhole Pipe Boot: Neoprene - EPDM blended compound boot, conforming to ASTM C 923, with stainless steel pipe clamp and internal expanding clamp. B. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

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

3.02 FIELD MEASUREMENTS

A. Make necessary measurements in the field to assure precise fit of items in accordance with the approved design.

3.03 INSTALLATION

A. Trench, backfill, and compact for the work of this Section in strict accordance with pertinent provisions of Section 31 23 20 of these Specifications. B. Location: 1. Where the sewer location is not located clearly by dimensions on the Drawings, locate the sewer: a. Not closer than ten feet from a water supply main or service line. b. Where the gravity flow sewers cross above water lines, fully encase the sewer pipe for a distance of ten feet on each side of the crossing; or c. Use acceptable pressure pipe with no joint closer horizontally than three feet from the crossing. d. Where concrete encasement is used, provide not less than 4" thickness including that on pipe joints. C. Pipe Laying: 1. Inspect pipe before laying. Remove and relay, or replace, laid pipe which is found to be defective or damaged, not in true alignment or to proper grade, or which shows undue settlement, at no additional cost. 2. Protect pipe during handling against shocks and free fall. Remove extraneous material from the pipe interior. 3. Lay pipe in dry trench, unless otherwise approved. 4. Check pipe for cracks, broken bells, and defects before lowering into trench. 6. Begin construction at outlet or low point of line. Do not begin construction of lateral lines until main or submain sewer has been completed to point where lateral line discharges into it. 7. Lay pipe by proceeding upgrade with the spigot ends of bell-and-spigot pipe pointing in direction of flow. 8. Lay each pipe accurately to the indicated line and grade, aligning so the sewer has a uniform invert. 9. Continually clear interior of the pipe free from foreign material. 10. Before making pipe joints, clean and dry all surfaces of the pipe to be joined. 11. Use lubricants, primers, and adhesives recommended for the purpose by the pipe manufacturer. 12. Place, fit, join, and adjust the joints to obtain the degree of water tightness required. D. Joints: 1. Join pipe with elastomeric gasket joints. 2. Install joints in compliance with manufacturer's instructions. 3. As soon as possible after joint is made, place backfill to prevent pipe movement off line or grade.

3.04 WYE BRANCHES

A. Provide wye branches where sewer connections are indicated or required. 1. Where joining an existing line, join by placing a saddle over the line, and make connection in a manner which will not obstruct or interfere with the existing flow. 2. When conditions are such that connection pipe cannot be supported adequately on undisturbed earth or compacted fill,

encase the pipe in a concrete backfill, or support on a concrete cradle. B. Provide concrete required because of conditions resulting from faulty construction methods or negligence, at no additional cost to the Owner.

3.05 MANHOLES

A. General: Construct as detailed, in compliance with requirements of Section 03 00 10 and standard specifications of State, County, City, Township or other governing authorities having jurisdiction at project site. Provide complete with frames, covers, and other appurtenances required for complete installation. 1. Shape the invert channels to be smooth and semicircular, conforming to the inside of the adjacent sewer section. 2. Make changes in direction of flow with a smooth curve of as large a radius as the size of the manhole will permit. 3. Make changes in size and grade of channels smoothly and evenly. 4. Form the invert channels directly in the concrete of the manhole base, with mortar, or by laying full section sewer pipe through the manhole and breaking out the top half after surrounding concrete has hardened. 5. Smooth the floor of the manhole outside the channels, and slope toward the channels at not less than 1" per foot nor more than 2" per foot. 6. Prevent free drop inside the manholes exceeding 18" measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels. 7. Construct drop manholes whenever the free drop otherwise would be greater than 24". 8. Use manhole pipe boot to provide seal between wall opening and pipe. 9. Connections to Existing Manholes: Make in manner so finish work conforms to essential requirements specified for new manholes, including required concrete work, cutting and shaping. B. Jointing and Plastering: 1. Completely fill mortar joints, and leave smooth and free from surplus mortar on the inside of the manhole. C. Frames and Covers: Unless otherwise shown on the Drawings, set frames and covers: 1. In Paved Areas: So that the top of the cover will be flush with the finished pavement; or 2. In Unpaved Areas: 2" higher than finished grade.

3.06 MANHOLE OVER EXISTING PIPE

A. Construct new manhole as specified, breaking upper half of existing pipe after base of manhole is completed so as not to obstruct flow of the existing pipe.

3.07 BUILDING CONNECTION

A. Terminate building connections where shown on the Drawings. B. Provide temporary closures at terminals where the building pipe is not installed. 1. Place marker post at grade end of plugged line. 2. Where building piping has been installed, make connection to the building piping system.

3.08 TESTING AND INSPECTING

A. Do not allow or cause any of the work of this Section to be covered up or enclosed until after it has been inspected and tested, and has been approved by the Engineer. B. Visual Test: All sewer lines shall be inspected visually by the Contractor and checked by the Engineer to verify accuracy of alignment and freedom from debris and obstructions. The full diameter of the pipe should be visible when viewed between consecutive manholes. The method of test can be photography, closed circuit television or visually lamping with mirrors and lights. C. Deflection Testing: The maximum allowable pipe deflection is 5%. If the Engineer directs as a result of the visual test, a "go, no-go" mandrel or sewer ball shall be used to prove pipe deflection is within allowable limits. The Contractor may, at his option, use a deflectometer, calibrated television or photography. D. Leakage Tests: 1. Test lines for leakage by exfiltration test. a. Prior to testing for leakage, backfill the trench to at least the lower half of the pipe. b. If required, place sufficient additional backfill to prevent pipe movement during testing,

leaving the joints uncovered to permit inspection. 2. Water Exfiltration Tests: a. Test each section of sewer line between successive manholes by closing the lower end of the sewer to be tested, and the inlet sewer of the upper manhole, using stoppers. b. Fill the manhole and pipe with water to a point four feet above the invert of the sewer at the center of the upper manhole; or, if groundwater is present, four feet above the average adjacent groundwater level. c. The allowable leakage per twenty-four hours per inch of diameter per mile of sewer tested shall not exceed 50 gallons. 3. Water Infiltration Test: a. If, in the opinion of the Engineer, excessive groundwater is encountered in the construction of a section of the sewer, the exfiltration test shall not be used. b. Close the end of the sewer at the upper structure sufficiently to prevent the entrance of water. c. Discontinue pumping of groundwater for at least three days, then test for infiltration. d. Infiltration into each individual reach of sewer between adjoining manholes shall not exceed that test, except that "H" in the formula shall be the difference between the groundwater surface and the invert of the sewer at the downstream manhole. 4. Provide and use measuring devices approved by the Engineer. 5. Provide water, materials, and labor for making required tests. 6. Make tests in the presence of the Engineer, giving the Engineer at least three days advance notice of being ready for test observation. E. Submit test data to the Engineer for review and approval.

END OF SECTION

DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 323119 - FENCES AND GATES

PART 1 – GENERAL

1.01 WORK INCLUDED
The contractor shall provide all labor, materials and appurtenances necessary for installation of the welded ornamental steel fence system.

1.02 RELATED WORK
Section 03300 - Concrete

1.03 SYSTEM DESCRIPTION
The manufacturer shall supply a total fence system of Montage II® *Welded and Rackable* (ATF – All Terrain Flexibility) Ornamental Steel (Classic™) design. The system shall include all components (i.e., panels, posts, gates and hardware) required.

1.04 QUALITY ASSURANCE
The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.05 REFERENCES
- ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- ASTM D523 - Test Method for Specular Gloss.
- ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
- ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.06 SUBMITTAL
The manufacturer’s literature shall be submitted prior to installation.

SECTION 323119 - FENCES AND GATES

1.07 PRODUCT HANDLING AND STORAGE
Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.08 PRODUCT WARRANTY
A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.

B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 – MATERIALS

2.01 MANUFACTURER
The fence system shall Standard Height – 8’-0” and conform to Montage II® *Welded and Rackable* (ATF – All Terrain Flexibility) Ornamental Steel, (Classic™) design, (specify extended picket) bottom rail treatment, (specify 4-Rail) style manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma.

2.02 MATERIAL
A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft2, Coating Designation G-90.

B. Material for pickets shall be 1” square x 14 Ga. tubing. The rails shall be steel channel, 1.75” x 1. 75” x .105”. Picket holes in the rail shall be spaced 4.715” o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.03 FABRICATION
A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.

B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar’s proprietary fusion

welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).

C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils. The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).

D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

E. Swing gates shall be Standard Height – 8’-0” and fabricated using 1.75” x 14ga Forerunner double channel rail, 2” sq. x 12ga. gate ends, and 1” sq. x 14ga. pickets. Gates that exceed 6’ in width will have a 1.75” sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6’.

All swing gates shall be Double Gate Arrangement – Montage II Genesis 4-rail style as manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma. Refer to drawings.

PART 3 – EXECUTION

3.01 PREPARATION
All new installation shall be laid out by the contractor in accordance with the construction plans.
3.02 FENCE INSTALLATION
Fence post shall be spaced according to Table 3, plus or minus ½”. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36” (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The “Earthwork” and “Concrete” sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods

such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.03 FENCE INSTALLATION MAINTENANCE
When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

3.04 GATE INSTALLATION
Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

3.05 CLEANING
The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

Table 1 – Minimum Sizes for Montage II Posts

Fence Posts	Panel Height		
3" x 12 Ga.	Over 6' Up to & Including 8' Height		
Gate Leaf	Gate Height		
			Over 6' Up to & Including 8'
6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
14'1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"

Table 2 – Coating Performance Requirements		
Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60˚ Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

	Table 3 – Montage II – Post Spacing By Bracket Type									
Span	For INVINCIBLE® 8′ Nominal (91-1/2" Rail)				For CLASSIC, GENESIS, & MAJESTIC 8′ Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount (BB301)*		Industrial Line 2-1/2" (BB319) 3" (BB320)		Industrial Universal 2.5" (BB302) 3" (BB303)		Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings ± ½" O.C.	94-1/2"	95"	94-1/2"	95"	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"
*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.										