

PROJECT MANUAL

FOR

**A NEW BRANCH BANK FOR
FIRST COMMUNITY BANK
202 GREENWOOD AVENUE – HWY. 135 & HOLMES STREET
Lepanto, AR**

February 8, 2023

RPPY PROJECT #1733

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END OF DOCUMENT

INVITATION TO BID

Project: A New Branch Bank for
First Community Bank
202 Greenwood Avenue – Hwy. 135 & Holmes Street
Lepanto, AR

Owner: First Community Bank
Mr. Dale Cole

Architect: Roark Perkins Perry & Yelvington

Date: February 8, 2023

Your firm is invited to submit a Bid to the Owner for construction of a new branch bank for First Community Bank located at the above address. The Owner will receive Bids until 2:00 PM local time on Thursday, the 16th day of March, 2023.

Description: Work includes site work, general construction, HVAC, plumbing and electrical work.

Identify Contract Time in the Bid Form. The completion date in the Agreement shall be the Contract Time added to the commencement date.

Copies of the Contract Documents are available for review at the office of the Architect and at Southern Reprographics. Invited general contractors may obtain one complete set of Contract Documents and one hard copy emailed to them by contacting the Architect. Additional copies of Contract Documents may be obtained at the cost of reproduction from Southern Reprographics. Bids submitted by General Contractors who obtain documents by any other means, will be disqualified.

Subcontractors and suppliers may visit www.sribids.com for viewing and or downloading of electronic documents at no cost. Access to this site requires that you enter the following information: RPPY1733.

Bidders will be required to provide Bid security in the form of a Bid Bond in the amount of 5 percent of the Bid Sum. Refer to other bidding requirements described in Document 00 21 13, and Document 00 31 00. Submit your Bid on the Bid Form provided.

Your Bid will be required to be submitted under a condition of irrevocability for a period of 60 days after submission. The Owner reserves the right to accept or reject any or all Bids.

Mr. Dale Cole
First Community Bank

Enclosures

END OF DOCUMENT

INSTRUCTIONS TO BIDDERS

1.1 SUMMARY

- A. Document Includes:
 - 1. Bid submission.
 - 2. Work identified in contract documents.
 - 3. Contract Time.
 - 4. Definitions.
 - 5. Contract Documents identification.
 - 6. Availability of documents.
 - 7. Examination of documents.
 - 8. Inquiries and addenda.
 - 9. Product substitutions.
 - 10. Site examination.
 - 11. Subcontractors.
 - 12. Submission procedure.
 - 13. Bid ineligibility.
 - 14. Security deposit.
 - 15. Performance assurance.
 - 16. Additional bid information.
 - 17. Bid opening.
 - 18. Duration of offer.
 - 19. Acceptance of offer.

- B. Related Documents:
 - 1. Document 00 11 16 - Invitation to Bid.
 - 2. Document 00 31 00 - Available Project Information.
 - 3. Document 00 41 13 - Bid Form.
 - 4. Document 00 41 43 - Bid Form Appendices.
 - 5. Document 00 73 13 - Supplementary Conditions

1.2 BID SUBMISSION

- A. Bids signed, executed, and dated will be received by the Owner and the Architect via email at allen.williams@firstcommunity.net and ty@rppyarchitects.com until 2:00 PM local time on Thursday, the 16th day of March, 2023.
- B. Bids submitted after the above time will be returned to Bidder unopened.
- C. Amendments to submitted Bids will be permitted when received in writing prior to bid closing and when endorsed by the same party or parties who signed and sealed the Bid.
- D. Bidders may withdraw their Bid by written request at any time before bid closing.

1.3 WORK IDENTIFIED IN CONTRACT DOCUMENTS

- A. Work of this proposed Contract comprises site development, and general construction, including civil, fire protection, structural, mechanical, and electrical Work.

B. Location: 202 Greenwood Avenue – Hwy. 135 & Holmes Street, Lepanto, AR.

1.4 CONTRACT TIME

- A. Identify Contract Time in the Bid Form. The completion date in the Agreement shall be the Contract Time added to the commencement date.
- B. The Owner requires the work of this contract be completed as quickly as possible. Consideration will be given to time of completion when reviewing submitted Bids.

1.5 DEFINITIONS

- A. Bidding Documents: Contract Documents supplemented with Invitation to Bid, Instructions to Bidders, Information Available to Bidders, Bid Form, Bid Form Appendices, and bid securities, identified.
- B. Contract Documents: Defined in AIA Document A201-2017 Article 1, including issued Addenda.
- C. Bid: Executed Bid Form and required attachments submitted in accordance with these Instructions to Bidders.
- D. Bid Sum: Monetary sum identified by the Bidder in the Bid Form.

1.6 CONTRACT DOCUMENTS IDENTIFICATION

- A. The Contract Documents are identified as Project number #1733 as prepared by RPPY Architects located at 713 W. 2nd Street in Little Rock, AR and as identified in the Project Manual.

1.7 AVAILABILITY OF DOCUMENTS

- A. Bidding Documents may be obtained as stated in Invitation to Bid.
- B. Partial sets of Bidding Documents will not be issued to general contract Bidders.
- C. Bidding Documents are made available only for the purpose of obtaining offers for this Project. Their use does not grant a license for other purposes.

1.8 EXAMINATION OF DOCUMENTS

- A. Bidding Documents may be viewed at the office of the Architect/Engineer and at Southern Reprographics.
- B. Upon receipt of Bidding Documents verify documents are complete. Notify Architect/Engineer if documents are incomplete.
- C. Immediately notify Architect/Engineer upon finding discrepancies or omissions in Bidding Documents.

1.9 INQUIRIES AND ADDENDA

- A. Direct questions in writing to Stephan Seng, at the office of the Architect/Engineer; ss@rppyarchitects.com.
- B. Verbal answers are not binding on any party.
- C. Submit questions not less than 3 days before date set for receipt of Bids. Replies will be made by Addenda.
- D. Addenda may be issued during bidding period. Addenda will be sent to known Bidders. Addenda become part of the Contract Documents. Include resultant costs in the Bid Sum.

1.10 PRODUCT SUBSTITUTIONS

- A. Requests for product substitutions are not permitted during bidding. Refer to Section 01 60 00 - Product Requirements for substitution procedures.
- B. In submission of substitutions to Products specified, Bidders shall include in their Bid, changes required in the Work and changes to Contract Time and Contract Sum to accommodate such approved substitutions. Later claims by the Bidder for an addition to the Contract Time or Contract Sum because of changes in Work necessitated by use of substitutions will not be considered.

1.11 SITE EXAMINATION

- A. Examine Project site before submitting a Bid.

1.12 SUBCONTRACTORS

- A. The Owner reserves the right to reject a proposed Subcontractor for reasonable cause.
- B. Refer to AIA Document A201-2017, Article 5 of General Conditions.

1.13 SUBMISSION PROCEDURE

- A. Bidders shall be solely responsible for delivery of Bids in manner and time prescribed.
- B. Submit one copy of executed offer on Bid Forms provided, signed with required security deposit in a closed opaque envelope, clearly identified with Bidder's name, Project name, and Owner's name on the outside.
- C. Improperly completed information, irregularities in bid bond, may be cause not to open the Bid Form envelope and declare the Bid invalid or informal.
- D. An abstract summary of submitted Bids will be made available to all Bidders following bid opening.

1.14 BID INELIGIBILITY

- A. Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind, may be declared unacceptable at Owner's discretion.
- B. Bid Forms, Appendices, and enclosures which are improperly prepared may be declared unacceptable at Owner's discretion.
- C. Failure to provide security deposit, bonds or insurance requirements may invalidate the Bid at the discretion of the Owner.
- D. Bids are by invitation, only, from selected Bidders. Unsolicited Bids will be returned.

1.15 SECURITY DEPOSIT

- A. Bids shall be accompanied by security deposit as follows:
 - 1. Bid Bond of a sum no less than 5 percent of the Bid Sum on standard surety company form.
- B. Endorse Bid Bond in name of the Owner as obligee, signed and sealed by the principal (Contractor) and surety.
- C. Security deposit of accepted Bidder will be returned after delivery to the Architect of the required Performance and Payment Bonds by the accepted Bidder.
- D. Include the cost of security deposit in the Bid Sum.
- E. After a Bid has been accepted, security deposits will be returned to the respective Bidders.
- F. If no contract is awarded, security deposits will be returned.

1.16 PERFORMANCE ASSURANCE

- A. Accepted Bidder: Provide a Performance and Payment bond as described in Document 00 73 13.
- B. Include the cost of performance assurance bonds in the Bid Sum and identify the cost when requested by the Owner.

1.17 ADDITIONAL BID INFORMATION

- A. Complete and submit Document 00 43 00 with Bid.

1.18 BID OPENING

- A. Bids will be opened publicly immediately after time for receipt of Bids.
- B. A final bid tabulation will be emailed to all bidders who submitted a bid.

1.19 DURATION OF OFFER

- A. Bids shall remain open to acceptance and shall be irrevocable for a period of 60 days after bid closing date.

1.20 ACCEPTANCE OF OFFER

- A. The Owner reserves the right to accept or reject any or all offers.
- B. After acceptance by the Owner and receipt of required insurance, the Architect/Engineer, on behalf of the Owner, will issue to the accepted Bidder, a written Notice to Proceed.
- C. Notwithstanding delay in the preparation and execution of the Agreement, accepted Bidder shall be prepared, upon written Notice to Proceed, to commence work within ten days following receipt of official written order of the Owner to proceed, or on date stipulated in such order.

END OF DOCUMENT

AVAILABLE PROJECT INFORMATION

1.1 SUMMARY

- A. Document Includes:
 - 1. Subsurface investigation report.
 - 2. Topographic survey.
 - 3. Existing conditions survey.
- B. Related Documents:
 - 1. Document 00 21 13 - Instructions to Bidders: Site examination.

1.2 SUBSURFACE INVESTIGATION REPORT

- A. A copy of a geotechnical report is included with this document, titled Geotechnical Engineering Exploration, First Community Bank, Lepanto, AR, dated January 27, 2023, and prepared by MTA Engineers.
- B. This report identifies properties of below grade conditions and offers recommendations for design of foundations, prepared primarily for use of Architect/Engineer.
- C. Recommendations described are not requirements of this Contract, unless specifically referenced in Contract Documents.
- D. This report, by its nature, cannot reveal all conditions existing on the site. Should subsurface conditions be found to vary substantially from this report, changes in design and construction of foundations will be made, with resulting credits or expenditures to Contract Price/Sum accruing to Owner.

END OF DOCUMENT

MTA ENGINEERS

- Geotechnical Engineering
- Materials Testing • Special Inspections
- Design

mtaengineers.com

GEOTECHNICAL ENGINEERING EXPLORATION

**First Community Bank
Lepanto, Arkansas**

PREPARED FOR:

First Community Bank
1325 Harrison Street
Batesville, AR 72501

PREPARED BY:

MTA ENGINEERS

8001 National Drive
Little Rock, AR 72209

January 27, 2023

Dale Cole
First Community Bank
1325 Harrison Street
Batesville, AR 72501

January 27, 2023

Subject: Report of Geotechnical Engineering Exploration
Proposed First Community Bank
Lepanto, Arkansas

Mr. Cole:

MTA Engineers has completed the authorized Geotechnical Engineering Exploration for the subject project. This work was conducted in accordance with the agreement between MTA Engineers and First Community Bank, which is detailed in MTA Engineers Proposal dated October 26, 2022.

The purpose of our work was to review general surface and subsurface conditions within the project site area, and to gather and present data relative to the design and construction of the proposed bank located in Lepanto, Arkansas. This report outlines the exploration procedures used, exhibits the data obtained, and presents our recommendations.

MTA Engineers appreciates this opportunity to provide these services and looks forward to working with you on future projects. Please contact us if you have any questions or require additional information.

Sincerely,

MTA ENGINEERS



Steve Garrett, PE
President/ Senior Geotechnical Engineer
Office +1 501-753-2526
steve@mtaengineers.com



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EXECUTIVE SUMMARY

The geotechnical exploration was conducted at the site for the proposed bank located at the southwest corner of the intersection between Greenwood Avenue and Holmes Street in Lepanto, Arkansas. At the time of our visit, the proposed bank area was covered with debris from the previous building and asphalt. There is a concrete vault present on the site. In general, the soils will consist of very soft and loose silty soils near surface, soft to firm clayey layers in the primary grades, and medium dense sandy soils at depths. Subsurface conditions were uniform throughout the entirety of the proposed development. The potential to find stumps or other organic material beneath the surface is low. Major soil types encountered at each boring may be summarized as follow:

Table 1. Soil Types Encountered

SOIL TYPE	DESCRIPTION
ML	Silt with Sand
CL / CH	Lean Clay / Expansive Clay
SC / SM	Silty Sand / Clayey Sand

Based on the nature of the existing strata encountered at the time of exploration, and due to the presence of moisture sensitive soils with low shear strength in all borings, it is assumed that the proposed improvements will be above existing grades. We recommend that the building pad should be raised a minimum of **3-ft** above existing grades to establish final grade. Due the presence of “CH” clay in the area, care should be taken to ensure a minimum clearance of **3-ft** between the “CH” and any bearing surface.

The surface silty soils are very soft and saturated; stability of these soils will affect site traffic at the time of construction. The site should be stripped of in the order of 12-in to remove all the construction debris. Depending on soil-moisture conditions at the time of construction and site grading, near surface soils may require undercutting or be stabilized at a depth of **12-in** with the addition of **5%** lime or cement by weight of soil. If lime is used, the PH of the soil-lime mixture should be at least **10** during placement at **12-in**. Depending on the soil moisture condition at the start of construction, the near surface soils may not support construction equipment.

Based on the anticipated bearing load, it is recommended that any building’s structure be supported on traditional shallow footings founded a minimum of **24-in** below final grade, within the properly compacted Structural fill. Footings founded as accounted may be designed with an allowable bearing capacity of **2,000-psf** for continuous and **2,500-psf** for individual spread footings.

The net allowable end bearing pressures are based on a safety factor in excess of **3.0** with respect to the anticipated shear strength of the bearing stratum. Total and differential settlement is anticipated to be less than **½ -in**.

SUMMARY

- **Rock/Hard Dig:**
 - No hard dig material was encountered within the depths explored.
 - The use of mini excavators will be limited with depth.

- **General Lots:**
 - The soil strata were generally consistent; Stratum I consisted of soft silty soils, Stratum II of soft clayey soils while Stratum III consisted of medium dense sandy layers.
 - Upon stripping, near surface soils should be processed or stabilized to facilitate traffic on site.
 - Final grade should be raised a minimum of **3-ft** above existing to achieve bearing. Over-excavation of low shear strength may be needed if the site can't be raised.
 - Fill should consist of compacted select fill having a minimum PI of **12%**.
 - Existing soils, in the current conditions, **will not** support construction traffic.

- **Foundations/Slabs:**
 - Shallow footings founded **24-in** below final grade, within the compacted Structural fill, may be sized using a bearing capacity of **2,000-psf** for continuous and **2,500-psf** for individual spread footings.
 - Rammed aggregates piers may be used if a higher bearing is required.
 - Alternatively, drilled piers founded a minimum of **15-ft** BGS may be use using a net allowable bearing of **4.000-psf**.

- **Un-compacted Fill:**
 - No un-compacted fill was encountered on the property during our exploration.

- **Stump/Organic Findings:**
 - The potential to find stumps or other organic material beneath the surface is low.

- **Pavement:**
 - Subgrade should consist of **24-in** Structural fill.
 - Generally, **8-in** of Aggregate Base and **3-in** of ACHM surface will be required in light duty areas.
 - Additional recommendations are discussed further in this report.

- **Miscellaneous:**
 - There are no known existing utilities (outside of easement) on the property.
 - Drainage will need to be established prior to start of any excavation.

INTRODUCTION

This exploration was requested in order to evaluate existing subsurface conditions and provide geotechnical design recommendations. The results of this exploration and the geotechnical design recommendations for site construction are presented in this report.

Exploration was accomplished by:

1. Drilling **5** boring locations up to **20-ft**, to explore subsurface soil, and groundwater conditions.
2. Obtaining samples from each stratum, within the accessible areas, using standard geotechnical sampling technique or standard penetration test.
3. Performing laboratory tests on various samples to determine pertinent engineering properties of the subsurface strata.
4. Analyzing field and laboratory test data to develop design recommendations.

Note! The scope of this geotechnical exploration did not include an environmental assessment to determine the presence of wetlands and/ or hazardous or toxic materials in the soil or groundwater on or near this site. If there is concern of wetlands or a hazardous/ toxic material presence, a qualified environmental assessment consultant should be contacted to perform a site investigation before construction begins.

FIELD EXPLORATION

Subsurface conditions at the site were explored by using dry auger methods and a split spoon sampler to a depth of up to **20-ft** at **5** boring locations. The approximate boring locations are shown on the Plan of Borings, Appendix A. Boring logs presenting descriptions of the soil strata encountered are included in Appendix B. Laboratory testing results of the different soil types are located in Appendix D.

Samples were obtained throughout the entirety of most locations in general accordance with Standard Penetration Sampling (SPT). The recorded N-Values (Blows per foot) are indicated on the Boring Logs in the Blows per foot column. All soil samples encountered were removed from the field in moisture tight containers and transported to our laboratory for further examination. At the lab, a visual classification was performed for each sample.

All various soil types were then analyzed for specific engineering properties. The dry auger drilling procedures facilitated observation of shallow groundwater conditions. No Groundwater was encountered within the depths explored. Very moist layers were encountered in most borings.

GENERAL SITE AND SUBSURFACE CONDITIONS

The exploration of the proposed First Community Bank was conducted on a property located at the southwest corner of the intersection between Greenwood Avenue and Holmes Street in Lepanto, Arkansas. It is recommended that final grade should be raised above existing to achieve proper drainage. The potential to find stumps or other organic material beneath the surface is low.

The stratigraphy encountered in the boring locations is summarized in Table 2. Subsurface conditions were consistent throughout the entirety of the proposed development. Borings were advanced to a depth of up to **20-ft** BGS within the proposed building and pavement areas using dry auger methods.

For a more detailed description of soils encountered while testing see the boring log sheets found in attached preliminary report.

Table2. General Strata Classification of Boring Logs

STRATA	DEPTH (ft)	GROUP SYMBOL	SOIL DESCRIPTION	SIGNIFICANT PROPERTIES
STRATUM I (a)	0 to 4 <i>(In B:1 & B:2)</i>	ML	Gray-Brown, Silt with Sand	Very Soft to Firm Unstable upon Saturation
STRATUM I (b)	0 to 2 - 4 <i>(In B:3 & B:4,)</i>	SM	Grayish Brown, Silty Sand	Very Loose to Loose Low Shear Strength
STRATUM II (a)	2 - 8 to 8 - completion	CL	Tan-Brown, Lean Clay / Brown, Clay with Sand	Medium Hard to Hard Moderate to High Bearing
STRATUM II (b)	4 - 8 to 8 - 15 <i>(In B:1 & B:5)</i>	CH	Tan-Brown-Gray, High Plasticity Clay	Soft to Firm High Shrink Swell Potential
STRATUM III	13 - 18 to completion	SM / SC	Grayish Brown, Silty Clay / Clayey Sand	Medium Dense

During our exploration, no groundwater was encountered within explored depths. There is a potential for perched groundwater to develop during wetter seasons. The significant properties and characteristics of the subsurface strata pertinent to design and constructions are:

- A. The topography of the site and planned building location.
- B. The anticipated bearing load.
- C. The presence of moisture sensitive soils with low shear strength in all borings.

LABORATORY TESTING

Description of the soils encountered in the borings was prepared in general accordance with applicable ASTM standards. The soil stratification shown on the boring logs represents soil conditions at the specific boring locations. There may be some variations that occur between or beyond the boring locations.

The stratification lines on the boring logs represent the approximate boundaries between soil types, but the actual transitions between soil layers in the subsurface of the proposed site may be gradual. Laboratory testing was performed to verify/evaluate classification, volumetric stability, and to determine water content. The results of all testing performed are represented in Appendix D Laboratory Test Summary.

ANALYSIS AND RECOMMENDATIONS

SITE PREPARATION

The surface soils are very soft and moisture sensitive, therefore cannot support construction traffic under current soil moisture conditions. Prior to the construction of any improvement, the site should be stripped off in the order of 12-in to remove all demolition debris and old asphalt pavement. Prior to the placement of any fill, near surface existing soils should be proof rolled to determine stability at the time of construction. Additional undercut or stabilization may be required depending on soil moisture content. The existing soils may be stabilized at a depth of **12-in** with the addition of **5%** lime or cement by weight of soil. Alternatively, fill may be placed off existing entrances. No trucks should be allowed on the existing subgrade. All trucks should remain on structural fill.

Due to the presence of moisture sensitive soils with low shear strength in all borings, it is recommended that final grades be placed above existing to achieve bearing the building pad should be raised a minimum of **3-ft** above existing grades to establish final grade. Structural fill should be placed as recommended in the *Structural Fill* section of the report. If grade raising is not feasible, over-excavation of up to **3-ft** BGS should be anticipated to achieve proper bearing for shallow foundations. Deep foundations may be used as an alternative.

Excavations should be performed using equipment adequate to perform the work. The use of mini excavators will be limited by depth. Positive drainage should be maintained throughout this process. The addition of excessive moisture could cause a significant loss of soil stability. Geotextiles and/or Geogrids may be used beneath the structural fill. The type of geotextile or geogrid will depend on the soil shear strength at the time of construction.

The potential exists for increased groundwater to develop above the "CH" clay during the wetter periods of the year, so consideration should be given to the incorporation of frequent French drains for the control of groundwater during wetter periods.

STRUCTURAL FILL

Fill should consist of approved materials, which are free of organic matter and debris. For approval, samples of the proposed fill material should be submitted to MTA Engineers for classification testing. Select fill consisting of low plasticity soil such as lean clay or clayey gravel classifying as SC, CL, or GC according to the Unified Soils Classification System are generally considered suitable. High plasticity clay soils (soils with a Liquid Limit above **50**) should not be used as fill. Rock fragments that are greater than **2-in** should not be included in engineered fill within the top **2-ft** in pavement areas and within the top **4-ft** beneath the buildings.

Due to the silty nature of the existing soil stratum and high soil water content, granular fill may be used. “Granufill” or other non-plastic fill may be placed in the building and parking areas. If granular fill is used, slope should be plated with fill having a minimum P.I of **12**. Placement of approved fill should be achieved in multiple thin lifts. Each lift should not exceed **8-in** in loose thickness. Compaction of these lifts should be performed with suitable equipment to achieve **95%** of the material’s modified proctor (ASTM D-1557) at optimum to **3%** above optimum moisture content. Care should be taken that all compaction recommendations are performed.

If cohesive soils are to be used, compaction should be performed using a kneading-type vibratory compactor, such as a vibratory sheepsfoot. The material should be broken down sufficiently to provide a dense matrix of particles. On-site soils of Stratum I are considered suitable for structural fill at the proper moisture content.

Table 3: Compaction Requirements

Material Type and Location	Minimum Compaction (% of ASTM D1557)	Allowable Variance in Moisture from Optimum
Structural Fill Beneath Pavement Sections	95%	-3 to +3 (Other Approved Select Fill)
Structural Fill Beneath Buildings	95%	-3 to +3 (Other Approved Select Fill)
Utility Backfill in Building Area and Pavement	95%	-3 to +3
Miscellaneous and Green Areas	90%	-3 to +3
Aggregate Base Course	95%	-3 to +3 at time of Compaction

BUILDING FOUNDATIONS

All foundations must satisfy two basic and independent design criteria. First, foundations must have acceptable factor of safety against bearing failure under maximum design loads. Secondly, movement of the foundation due to consolidation, shrinkage, and/or swelling of the supporting strata should not exceed tolerable limits for the structure.

Construction factors such as installation of foundations units, excavation procedures, and surface and groundwater conditions should also be considered. The factors and the aforementioned subsurface conditions were influential in development of the following recommendation. In view of the anticipated foundation loading and subsurface conditions encountered, it is recommended that the proposed structures be supported on a foundation system designed in accordance with the following recommendations.

FOUNDATIONS/ SLABS

Shallow Foundations

Based on the nature of the existing soil encountered at the time of exploration and the anticipated loading, it is recommended that all structures be supported on traditional shallow footings. All footings should be founded a minimum of **24-in** beneath final exterior grade, within the properly compacted Structural fill.

Traditional shallow footings founded as accounted, may be designed using a net allowable end bearing pressure of **2,000-psf** for continuous and **2,500-psf** for individual spread footings. The net allowable end bearing pressures are based on a factor of safety in excess of **3.0** with respect to the anticipated shear strength of the bearing stratum. Total and differential settlement is anticipated to be less than **½ -in**.

Due the presence of "CH" clay in the area, care should be taken to ensure a minimum clearance of **3-ft** between the "CH" clay and any bearing surface, to reduce the shrink swell effect within the "CH" layers.

Slab-on-grade type construction is considered appropriate for the floor slab. We recommend that the slab be supported on **4-in** of clean crushed stone or gravel (ASTM C-33 #57 or equivalent) on prepared subgrade. A Class **A** impervious moisture barrier with a minimum thickness of **10-mils**, specified according to ASTM E-1745, should be provided between slab and the granular fill due to the potential for perched water to develop during the wetter seasons.

Deep Foundations

Rammed Aggregate Piers

We recommend the following alternative foundation for the proposed bank. This is an intermediate foundation comprised of footings supported on a bearing stratum improved with rammed-aggregate piers. This type of foundation may still require some localized undercut of weak on-site soils. Bearing capacity of the foundation soils can be improved and the settlement potential reduced. For this use, the Geopier® system is recommended. With the use of rammed aggregate piers, the foundation soils will be reinforced by installing Geopier elements below load-bearing foundations. Geopier elements are typically constructed by drilling **24 to 30-in** diameter holes and ramming thin lifts of well-graded aggregate, typically crushed stone aggregate base or graded sand, within the holes to form very stiff, high density aggregate piers.

The first lift of aggregate backfill forms a bulb below the bottoms of the Geopier elements, thereby prestressing and pre-straining the soils to an approximate depth below the element equal to **1 pier diameter**. Subsequent lifts of aggregate backfill are typically about **12-in** thick. Ramming takes place with a high-energy beveled tamper that both densifies the aggregate and forces the aggregate laterally into the sidewalls of the hole. This action increases the lateral stress in the surrounding soil, further stiffening the stabilized composite soil mass. The result of Geopier installation is a strengthening and stiffening of foundation soils that may then support relatively high bearing pressure spread footings.

Based on the subsurface conditions revealed by the boring logs, the drilled holes for Geopier® elements are expected to extend on the order of **13-ft** below footing bottoms, depending on the specific magnitude of loads and the subsurface conditions. We recommend that all rammed aggregate pier excavations extend to depths that fully extend through any on-site fill and any undercut backfill. Considering the subsurface conditions revealed by the completed borings, a preliminary maximum net allowable composite bearing pressure value on the order of **3,000-psf** is anticipated for individual and continuous footings supported over Geopier elements. For foundations with sustained dynamic loads, we recommend that the allowable bearing values be reduced by **50%**.

A footing-to-Geopier element area ratio of **20% to 30%** is expected. Specific design recommendations must be developed by Geopier Foundation Company. We recommend that final design be based on a maximum total settlement of about **1.0-in** and differential settlement less than **0.5-in**. Uplift resistance of footings will be developed by the weight of the structure and the foundation units. Uplift resistance can also be developed by designing the Geopier with embedded anchors. An individual Geopier uplift capacity of **40 to 60-kips** of tensile load would be expected for this site. Where uplift loads are a significant design component, we recommend that tensile capacity be verified by an uplift load test.

For resistance to sliding, an ultimate passive resistance value of **150-psf-per-ft** may be assumed for the stable on-site soils and compacted fill below **2-ft** depth. An ultimate composite coefficient of sliding value of **0.4** may be utilized in evaluation of sliding for concrete on the composite soil/Geopier bearing stratum. An appropriate factor of safety must be included in evaluation of sliding resistance. For perimeter footings and footings in unheated areas, a minimum footing depth of **2-ft** below lowest adjacent grade is recommended in conjunction with rammed aggregate piers.

Interior footings may be supported at shallower depth consistent with structural requirements for thickness. Minimum footing dimensions of **24-in** for individual and continuous footings are also recommended. Temporary casing could be required for some rammed aggregate pier construction, depending on as-built Geopier element depth and specific groundwater levels. Subgrade preparation/site preparation prior to rammed aggregate pier construction must include undercut and replacement of unstable soils. Localized undercuts of **2-ft** to **4-ft**, could be warranted.

All undercut backfill should be compatible with rammed aggregate pier construction. Clayey sand, clayey gravel, sand, crushed stone base, or approved alternatives are suitable for undercut backfill. Geopier® design and construction must be provided by Designers and Contractors licensed by Geopier Foundation Company, Inc. Specific design, construction, and cost information can be obtained from Geopier Foundation Company. If warranted, MTA will provide Geopier Foundation Company all logs of the existing soil stratum and a copy of this report for use in their design.

Drilled Piers

Alternatively, in order to limit over-excavation, it is recommended that the multi-storied structure be supported on drilled piers. Drilled piers, founded a minimum of **15-ft** beneath existing elevation and, may be designed using an allowable end bearing of **4,000-psf**. Skin friction may be added for increased bearing. The first **5-ft** should be omitted from calculations. In addition, a minimum pier diameter of **12-in** is recommended. Using larger pier diameters may allow for easier clearing of fractured sandstone encountered prior to completion depth.

The following skin friction parameters may be used:

<u>Depth (feet beneath final grade)</u>	<u>Skin Friction per Area of Pier (F.S of 2)</u>
0 to 5	Omit
5 to 15	300-psf

Depending on weather conditions at the time of construction, perched groundwater may be present within the pier excavations. Water greater than **2-in** in depth should be pumped prior to placement of concrete. A tremie may be used to place the concrete in the pier if groundwater is significant. All piers should be clean of all cuttings prior to placement of concrete.

The net allowable end bearing pressure is based on a factor of safety in excess of **2.0** with respect to the anticipated shear strength of the bearing stratum. Total and differential settlement is anticipated to be less than **½ -in.**

PAVEMENT DESIGN

Paved parking and drives will be constructed as part of the project. Design traffic volumes and loadings have not been determined. However, we anticipate that the paved drives will be subject to light vehicles and weekly service trucks. We anticipate that the drives will be placed at/or above the existing elevation.

The following design criteria were used to develop the recommended pavement sections in conjunction with the AASHTO Design Guide 1996:

Table 4. Pavement Design Assumption Values

PAVEMENT DESIGN ASSUMPTION VALUES	
CBR	5
R-VALUE	15
SOIL SUPPORT VALUE	5

Based on information obtained during this study, subgrade soils in the paved areas should generally consist of recompacted soils of Stratum I, or Structural fill. Any determined unstable soil (moist & loose layers) near subgrade's elevation should be scarified and recompacted. If the existing asphalt is left in place, it should be perforated prior to the placement of any fill.

Due the presence of "CH" clay in the area, care should be taken to ensure a minimum clearance of **2-ft** between the "CH" clay and any bearing surface, to reduce the shrink swell effect within the "CH" layers.

Structural fill, where required, should be placed as recommended in the site grading section of the report. It is recommended that positive site drainage should be provided during construction and be incorporated during the final design.

Table 5. Pavement Design Recommendations

PAVEMENT DESIGN RECOMMENDATIONS	
Standard Duty Asphalt Paving	2-in ACHM Surface Course
	8-in Crushed Stone Base Course
	12-in Compacted Subgrade
Heavy Duty Asphalt Paving	3-in ACHM Surface Course
	8-in Crushed Stone Base Course
	12-in Compacted Subgrade
Standard Duty Concrete Paving	5-in concrete pavement
	6-in Crushed Stone Base Course
	12-in Compacted Subgrade
Heavy Duty Concrete Paving & Dumpster Pad	6-in Concrete Pavement
	6-in Crushed Stone Base Course
	12-in Compacted Subgrade

Note: All pavement sections must comply with the city minimum requirements. It should be recognized that some periodic maintenance of pavement will be required. As a minimum, this should include periodic sealing of all joints and cracks to prevent surface water infiltration.

UN-COMPACTED FILL

No un-compacted fill was encountered on the property during our exploration. A minimum of **12-in** of stripping or a removal will be required.

STUMP/ ORGANIC FINDINGS

The potential to find organic material below the surface is very low.

SEISMIC CONSIDERATION

Based on IBC-2015, a site soil **Class D** may be used for design purpose. Liquefaction potential of the soils in Stratum I, II & III is negligible. Additional design information on Seismic Consideration is attached as Appendix E.

CONSTRUCTION PROCEDURES

The potential exists for groundwater to develop during wetter seasons. Therefore, foundations excavation and any other site grading should be performed during drier periods to reduce the possibility of changes in conditions.

Subsurface conditions significantly at variance with those encountered within the borings should be brought to the attention of the engineer, and work delayed pending evaluation and/or preparation of additional recommendations, if warranted.



The following illustrations are attached and complete this report:

- Appendix A: Plan of Excavation
- Appendix B: Borings Logs
- Appendix C: Key to terms and Symbols
- Appendix D: Laboratory Test Results
- Appendix E: Seismic Design Criteria



Appendix A: Boring Location Plan



Appendix B: Boring Logs



Boring Log Report

BORING NO. B-1
 PAGE 1 OF 1

JOB NO. GEO22-373
 JOB NAME: FIRST COMMUNITY BANK
 COORDINATES: NORTH: _____ EAST: _____
 STATION: _____
 LOCATION: LEPANTO, AR

DATE: 1/16/2023
 TYPE OF DRILLING: DRY AUGER
 EQUIPMENT: TMG CSR-174
 LOGGED BY: CADEN
 DRILLED BY: P.KING

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	PLASTICITY INDEX	PERCENT PASSING #200	NO. OF BLOWS PER 6-IN.	N-Value
			GRAY-BROWN, SILT W/ SAND, MOIST, FIRM	ML	NP	23.6	NV		79.6	3 4-3	7
			TAN-BROWN, LEAN CLAY, MOIST, SOFT	CL	22		48	26	89.9	2 2-3	5
5			GRAY-BROWN-TAN, LEAN CLAY, MOIST, FIRM							2 3-4	7
10										2 3-5	8
15											
20			Boring Terminated								
25											
30											

COMPLETION DEPTH: 20 WATER DEPTH> INITIAL: _____ AFTER 24 HOURS: _____

REMARKS:



Boring Log Report

BORING NO. **B-2**
 PAGE **1** OF **1**

JOB NO. GEO22-373
 JOB NAME: FIRST COMMUNITY BANK
 COORDINATES: NORTH: _____ EAST: _____
 STATION: _____
 LOCATION: LEPANTO, AR

DATE: 1/16/2023
 TYPE OF DRILLING: DRY AUGER
 EQUIPMENT: TMG CSR-174
 LOGGED BY: CADEN
 DRILLED BY: P.KING

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	PLASTICITY INDEX	PERCENT PASSING #200	NO. OF BLOWS PER 6-IN.	N-Value
			GRAY-BROWN, SILT W/ SAND, MOIST, VERY SOFT TO SOFT	ML	NP	26.7	NV		73.2	WOH 1-1	2
			TANNISH BROWN, HIGH PLASTICITY CLAY, SOFT TO FIRM	CH	28	33.4	74	46	96.5	1	4
5										2-2	2
			BROWN-GRAY-TAN, LEAN CLAY, FIRM	CL						2-3	6
										2	6
10										2-4	2
			BROWN, CLAYEY SAND, MEDIUM DENSE	SC						2	10
15										3-4	2
20			Boring Terminated							3	11
										4-7	
25											
30											

COMPLETION DEPTH: 20 WATER DEPTH> INITIAL: AFTER 24 HOURS:

REMARKS:



Boring Log Report

BORING NO. **B-3**
 PAGE **1** OF **1**

JOB NO. GEO22-373
 JOB NAME: FIRST COMMUNITY BANK
 COORDINATES: NORTH: _____ EAST: _____
 STATION: _____
 LOCATION: LEPANTO, AR

DATE: 1/16/2023
 TYPE OF DRILLING: DRY AUGER
 EQUIPMENT: TMG CSR-174
 LOGGED BY: CADEN
 DRILLED BY: P.KING

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	PLASTICITY INDEX	PERCENT PASSING #200	NO. OF BLOWS PER 6-IN.	N-Value
			GRAYISH BROWN, SILTY SAND, MOIST, VERY LOOSE TO LOOSE	SM	NP	19.0	NV		43.8	WOH 1-1	2
										1	3
					16	31.6	33	17	95.3	1-2	4
5			TAN-BROWN, LEAN CLAY, MOIST, SOFT	CL						2	4
										3-1	
										2	4
										1-3	
10			BROWNISH GRAY, HIGH PLASTICITY CLAY, MOIST, SOFT TO FRIM	CH						2	6
										3-3	
										2	9
15										6-3	
			GRAYISH BROWN, SILTY SAND, MEDIUM DENSE	SM						2	11
20										4-7	
			Boring Terminated								
25											
30											

COMPLETION DEPTH: 20 WATER DEPTH> INITIAL: _____ AFTER 24 HOURS: _____

REMARKS:



Boring Log Report

BORING NO. B-4
 PAGE 1 OF 1

JOB NO. GEO22-373
 JOB NAME: FIRST COMMUNITY BANK
 COORDINATES: NORTH: _____ EAST: _____
 STATION: _____
 LOCATION: LEPANTO, AR

DATE: 1/16/2023
 TYPE OF DRILLING: DRY AUGER
 EQUIPMENT: TMG CSR-174
 LOGGED BY: CADEN
 DRILLED BY: P.KING

DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	PLASTICITY INDEX	PERCENT PASSING #200	NO. OF BLOWS PER 6-IN.	N-Value
			GRAYISH BROWN, SILT SAND, MOIST, VERY LOOSE	SM						WOH 2-1	3
			BROWN, LEAN CLAY W/ SAND, MOIST, VERY SOFT	CL	20	25.9	33	13	78.2	WOH 1-1	2
5										1	3
			BROWNISH GRAY, HIGH PLASTICITY CLAY W/ SAND, MOIST, FIRM TO SOFT	CH	29	26.8	69	40	84.8	WOH 3-3	6
10										WOH 2-2	4
			GRAYISH BROWN, CLAYEY SAND, MOIST, MEDIUM DENSE	SC						4	10
15										5-5	
			Boring Terminated								
20											
25											
30											

COMPLETION DEPTH: 15 WATER DEPTH> INITIAL: _____ AFTER 24 HOURS: _____

REMARKS:



Boring Log Report

BORING NO. B-5
 PAGE 1 OF 1

JOB NO. GEO22-373
 JOB NAME: FIRST COMMUNITY BANK
 COORDINATES: NORTH: _____ EAST: _____
 STATION: _____
 LOCATION: LEPANTO, AR

DATE: 1/16/2023
 TYPE OF DRILLING: DRY AUGER
 EQUIPMENT: TMG CSR-174
 LOGGED BY: CADEN
 DRILLED BY: P.KING

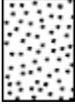
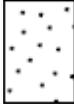
DEPTH FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SOIL GROUP	PLASTIC LIMIT	% MOIST.	LIQUID LIMIT	PLASTICITY INDEX	PERCENT PASSING #200	NO. OF BLOWS PER 6-IN.	N-Value
			BROWN, CLAYEY SAND, MOIST, VERY LOOSE	SC	13	52.6	30	17	44.6	WOH 1-1	2
			BROWN, LEAN CLAY W/ SAND, SOFT TO FIRM	CL						1	3
5										2	6
										3-3	
										2	7
10										4-3	
										WOH 3-6	9
15			BROWN, CLAYEY SAND, MEDIUM DENSE	SC	13	20.0	29	16	34.3	3 5-6	11
			Boring Terminated								
20											
25											
30											

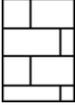
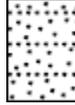
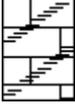
COMPLETION DEPTH: 15 WATER DEPTH> INITIAL: _____ AFTER 24 HOURS: _____

REMARKS:

Appendix C: Key to Terms

TERMS AND SYMBOLS USED ON BORING LOGS

SOIL TYPES			
	CLAY (CH)		SILTY CLAY (CL)
	CLAY (CL)		SANDY CLAY (CL)
	WELL-GRADED SAND (SW)		POORLY-GRADED SAND (SP)
	WELL-GRADED GRAVEL (GW)		POORLY-GRADED GRAVEL (GP)
	CLAYEY GRAVEL (GC)		SILT (ML)
	SILT (MH)		SANDY SILT (ML)
	SILTY GRAVEL (GM)		FILL MATERIAL

ROCK TYPES			
	LIMESTONE		SHALE
	SANDSTONE		WEATHERED LIMESTONE
	WEATHERED SHALE		WEATHERED SANDSTONE

SAMPLER TYPE			
	SHELBY TUBE SAMPLE		SPLIT SPOON SAMPLE
	AUGER SAMPLE		NO RECOVERY

SOIL GRAIN SIZE

U.S. STANDARD SIEVE								
12"	3"	3/4"	4	10	40	200		
BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		
304	76.2	19.1	4.75	2	0.42	0.074	0.002	
SOIL GRAIN SIZE IN MILIMETERS								

TERMS DESCRIBING CONSISTENCY OR CONDITION

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

DESCRIPTIVE TERMS	N VALUE	RELATIVE DENSITY
VERY LOOSE	0-4	0 – 15 %
LOOSE	4-10	15 – 35 %
MEDIUM DENSE	10-30	35 – 65 %
DENSE	30-50	65 – 85 %
VERY DENSE	50 and above	85 – 100 %

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

DESCRIPTIVE TERMS	N VALUE	UNCONFINED COMPRESSIVE STRENGTH TON / SQ. FT.
VERY SOFT	0-3	less than 0.25
SOFT	3-6	0.25 - 0.50
FIRM	6-12	0.50 - 1.00
STIFF	13-20	1.00 - 2.00
VERY STIFF	20-50	2.00- 4.00
HARD	50 and above	4.00 and higher

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

TERMS CHARACTERIZING MOISTURE CONTENT

DRY: No water evident in sample; fines less than plastic limit.

MOIST: Sample feels damp; fines near the plastic limit.

VERY MOIST: Water visible on sample; fines greater than plastic limit and less than liquid limit.

WET: Sample bears free water; fines greater than liquid limit.

TERMS CHARACTERIZING SOIL STRUCTURE

SLICKENSIDED: Having inclined planes of weakness that are slick and glassy in appearance.

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

LAMINATED: Composed of thin layer of varying color and texture.

INTERBEDDED: Composed of alternate layers of different soil types

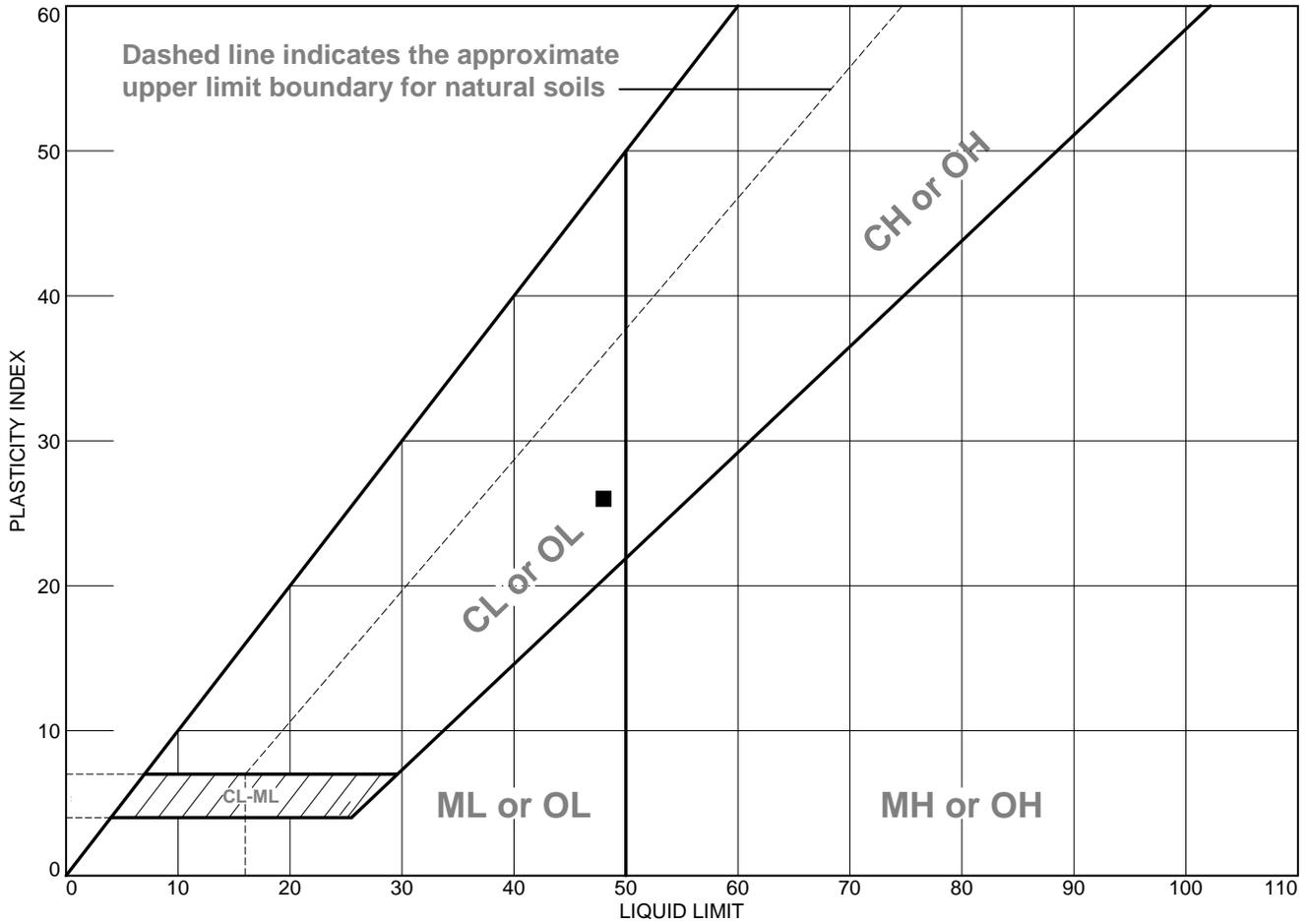
CALCAREOUS: Containing appreciable quantities of calcium carbonate.

WELL GRADED: Having wide range in grain sizes and substantial amounts of all intermediate particle size.

POORLY GRADED: Predominantly of one grain size, or having a range of sizes with some intermediate size missing

Appendix D: Laboratory Test Summary

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	GRAY-BROWN, SILT WITH SAND	NV	NP	NP	99.5	79.6	ML
■	GRAY-BROWN-TAN, LEAN CLAY	48	22	26	99.0	89.9	CL

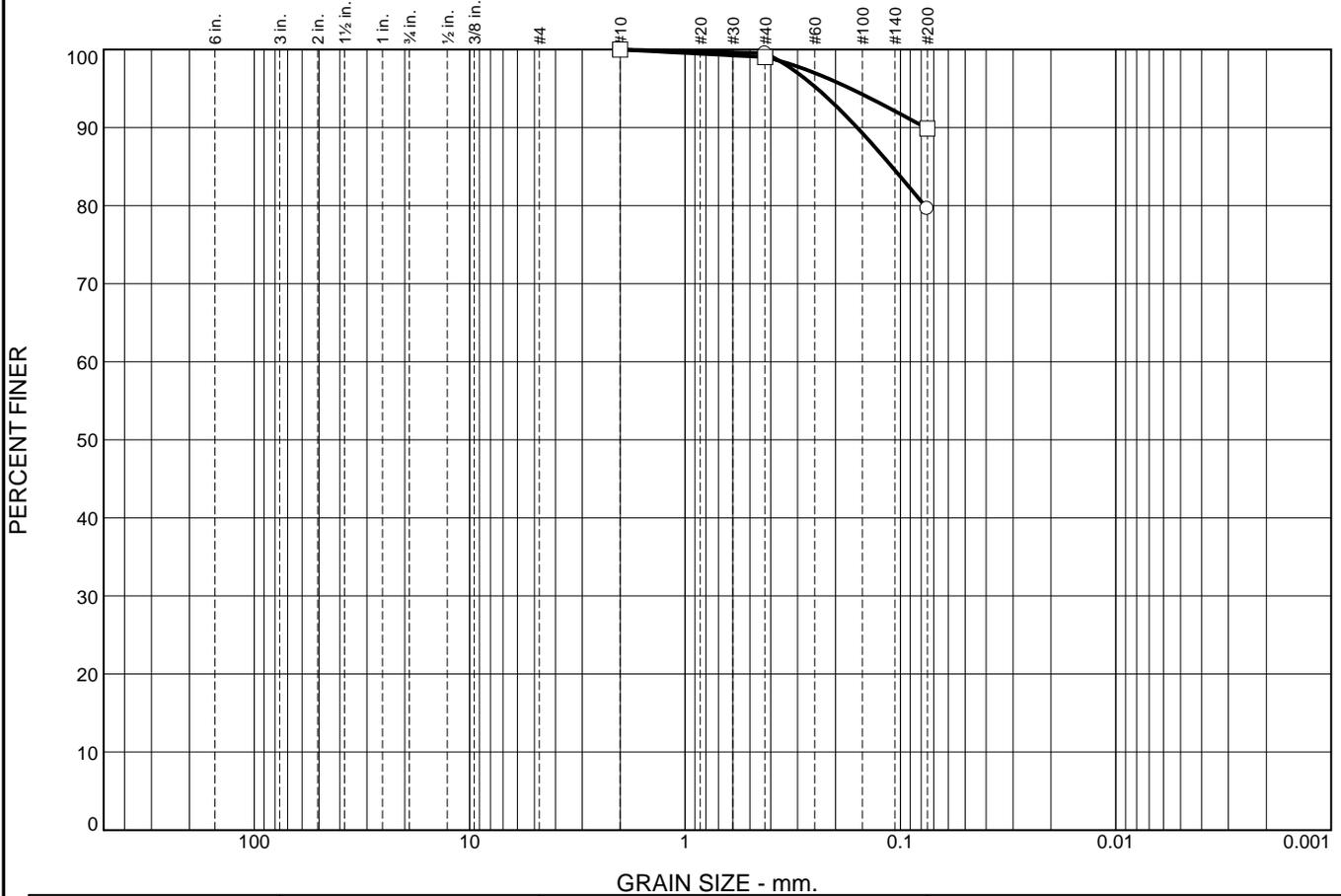
Project No. GEO22-373 **Client:**
Project: FIRST COMMUNITY BANK
● Source of Sample: B-1 **Depth:** 2
■ Source of Sample: B-1 **Depth:** 6

Materials Testing of Arkansas
Little Rock, AR

Remarks:

Figure

Particle Size Distribution Report

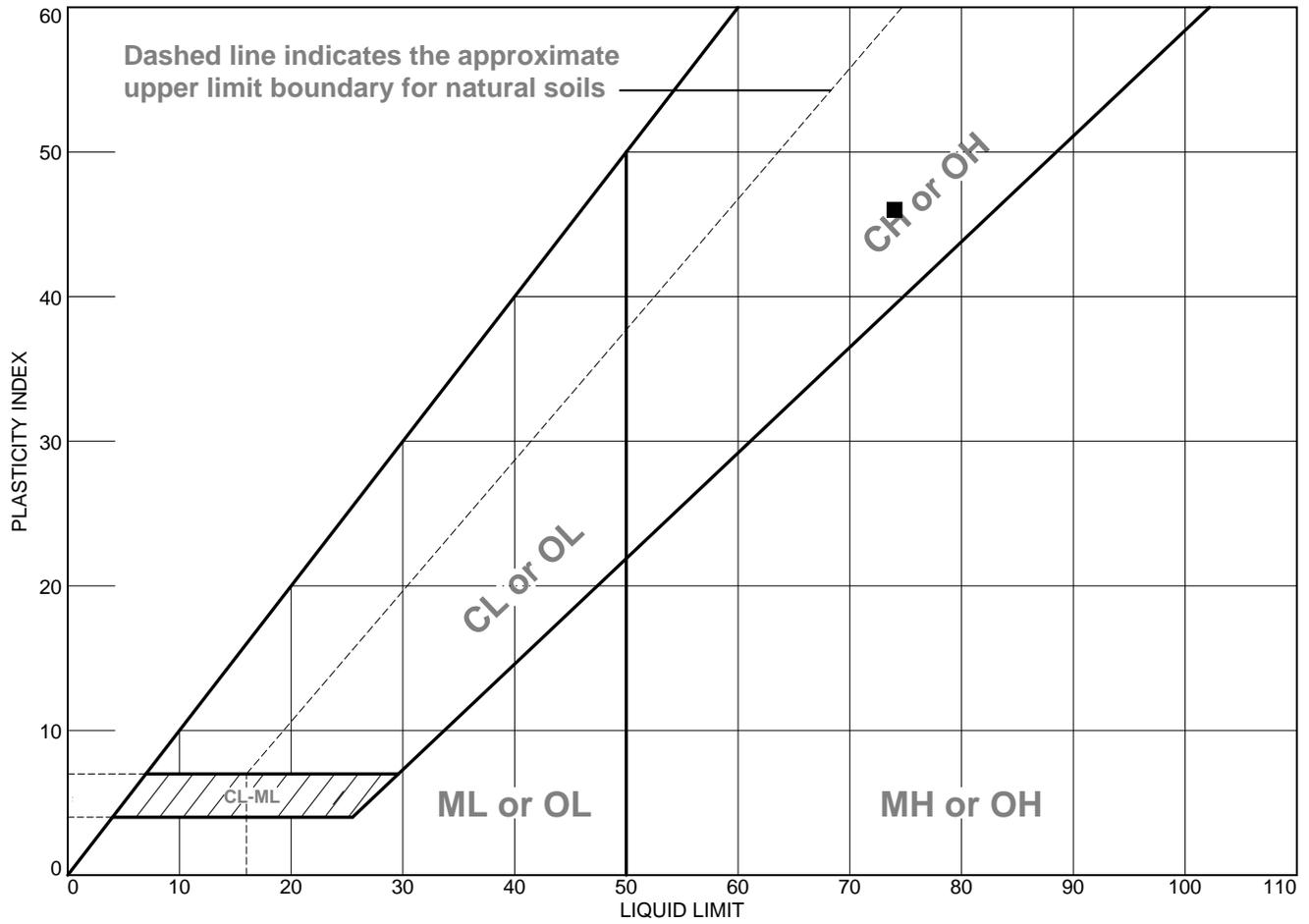


	% +3"	% Gravel		% Sand			% Fines			
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay		
<input type="radio"/>	0.0	0.0	0.0	0.0	0.5	19.9	79.6			
<input type="checkbox"/>	0.0	0.0	0.0	0.0	1.0	9.1	89.9			
<input checked="" type="checkbox"/>	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
<input type="radio"/>	NV	NP	0.1095							
<input type="checkbox"/>	48	22								

Material Description	USCS	AASHTO
<input type="radio"/> GRAY-BROWN, SILT WITH SAND	ML	A-4(0)
<input type="checkbox"/> GRAY-BROWN-TAN, LEAN CLAY	CL	A-7-6(25)

<p>Project No. GEO22-373 Client:</p> <p>Project: FIRST COMMUNITY BANK</p> <p><input type="radio"/> Source of Sample: B-1 Depth: 2</p> <p><input type="checkbox"/> Source of Sample: B-1 Depth: 6</p>	<p>Remarks:</p>
<p>Materials Testing of Arkansas</p> <p>Little Rock, AR</p>	
<p>Figure</p>	

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	GRAY-BROWN, SILT WITH SAND	NV	NP	NP	99.1	73.2	ML
■	TANNISH BROWN, FAT CLAY	74	28	46	99.3	96.5	CH

Project No. GEO22-373 Client:

Project: FIRST COMMUNITY BANK

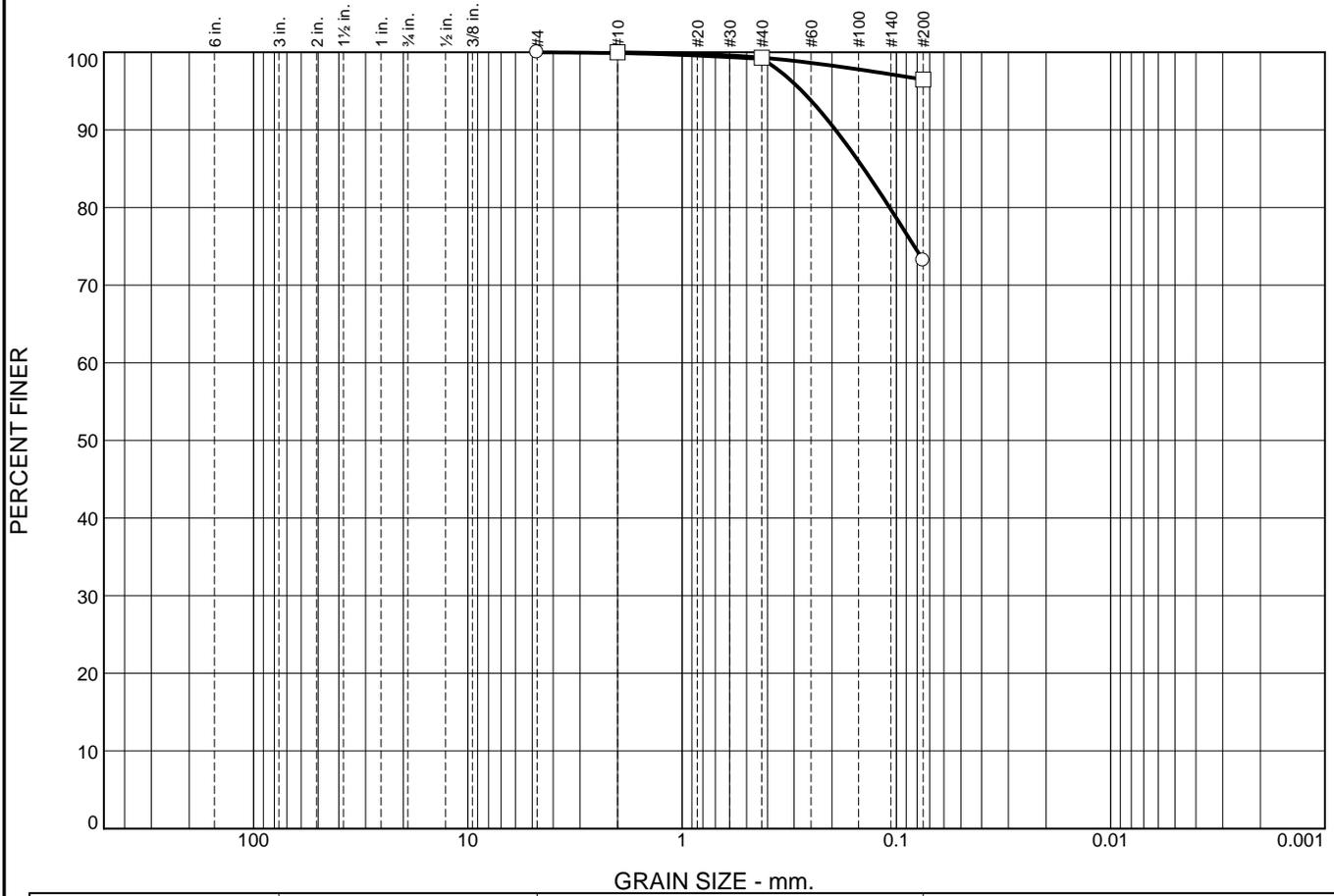
● Source of Sample: B-2 Depth: 2

■ Source of Sample: B-2 Depth: 6

Remarks:

Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	0.8	25.9	73.2	
□	0.0	0.0	0.0	0.0	0.7	2.8	96.5	

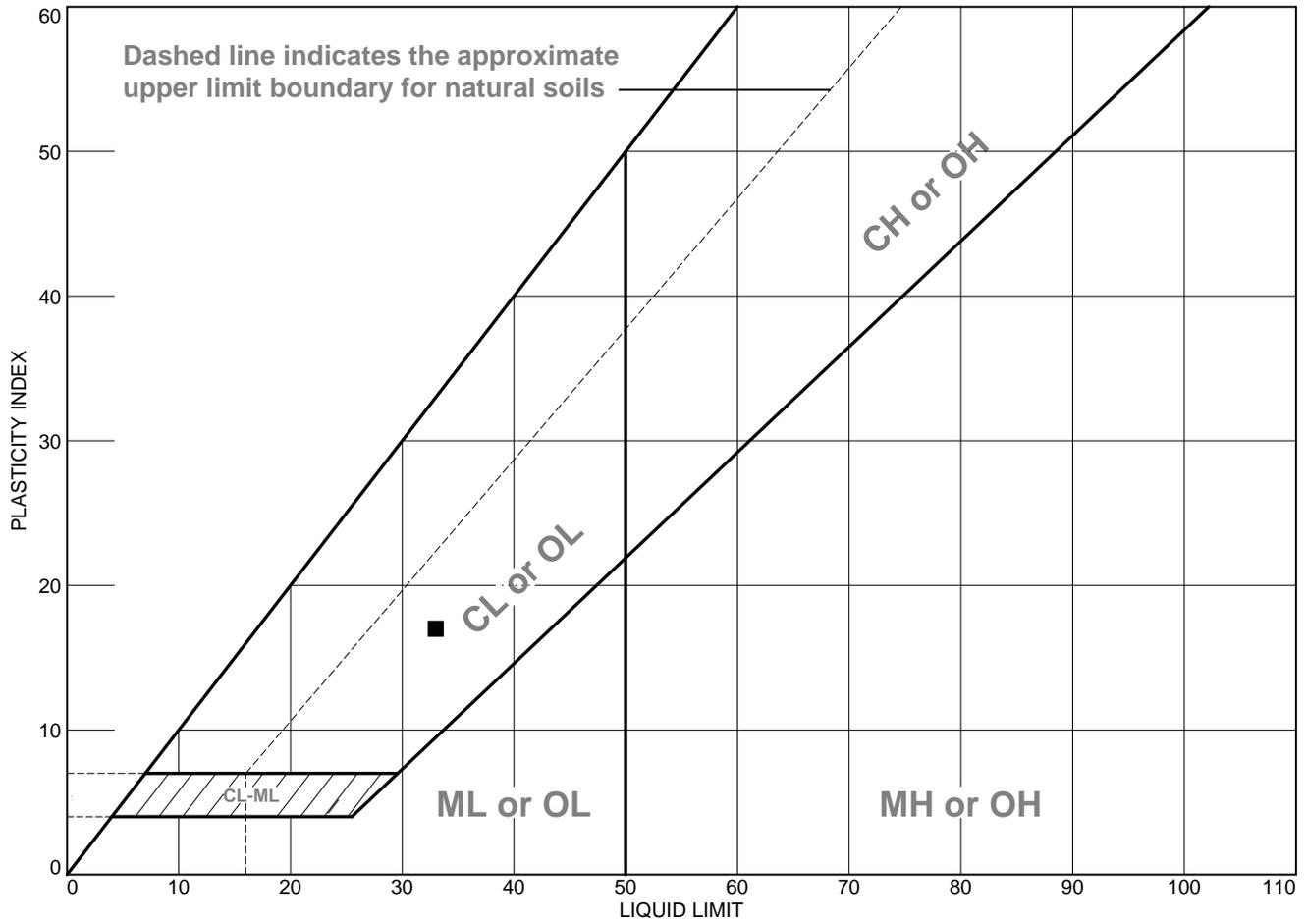
	LL	PL	D85	D60	D50	D30	D15	D10	Cc	Cu
	○	NV	NP	0.1419						
□	74	28								

Material Description	USCS	AASHTO
○ GRAY-BROWN, SILT WITH SAND	ML	A-4(0)
□ TANNISH BROWN, FAT CLAY	CH	A-7-6(52)

<p>Project No. GEO22-373 Client:</p> <p>Project: FIRST COMMUNITY BANK</p> <p>○ Source of Sample: B-2 Depth: 2</p> <p>□ Source of Sample: B-2 Depth: 6</p>	<p>Remarks:</p>
<p>Materials Testing of Arkansas</p> <p>Little Rock, AR</p>	

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	GRAYISH BROWN, SILTY SAND	NV	NP	NP	81.2	43.8	SM
■	TAN-BROWN, LEAN CLAY	33	16	17	97.3	95.3	CL

Project No. GEO22-373 Client:
 Project: FIRST COMMUNITY BANK

● Source of Sample: B-3 Depth: 0
 ■ Source of Sample: B-3 Depth: 4

Remarks:

Materials Testing of Arkansas
 Little Rock, AR

Figure

Particle Size Distribution Report



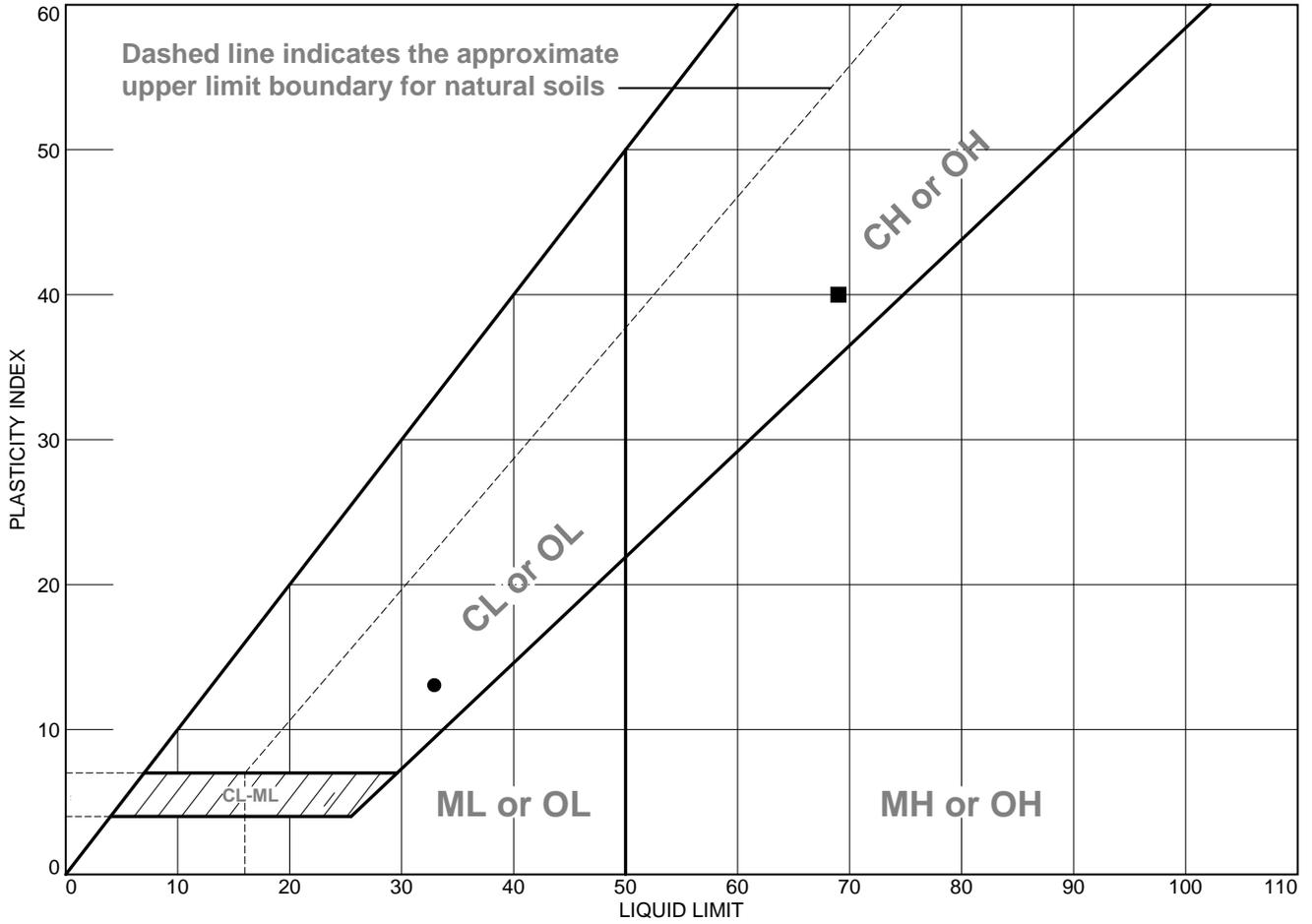
GRAIN SIZE - mm.										
%	+3"	% Gravel		% Sand			% Fines			
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay		
<input type="radio"/>				2.6	11.1	37.4	43.8			
<input type="checkbox"/>	0.0	0.0	0.0	1.0	1.7	2.0	95.3			
<input checked="" type="checkbox"/>	LL	PL	D85	D60	D50	D30	D15	D10	Cc	Cu
<input type="radio"/>	NV	NP	0.5790	0.1447	0.0961					
<input type="checkbox"/>	33	16								

Material Description	USCS	AASHTO
<input type="radio"/> GRAYISH BROWN, SILTY SAND	SM	A-4(0)
<input type="checkbox"/> TAN-BROWN, LEAN CLAY	CL	A-6(16)

<p>Project No. GEO22-373 Client:</p> <p>Project: FIRST COMMUNITY BANK</p> <p><input type="radio"/> Source of Sample: B-3 Depth: 0</p> <p><input type="checkbox"/> Source of Sample: B-3 Depth: 4</p>	<p>Remarks:</p>
<p>Materials Testing of Arkansas</p> <p>Little Rock, AR</p>	

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	BROWN, LEAN CLAY W/ SAND	33	20	13	99.5	78.2	CL
■	BROWNISH GRAY, FAT CLAY W/ SAND	69	29	40	99.7	84.8	CH

Project No. GEO22-373 **Client:**
Project: FIRST COMMUNITY BANK
● Source of Sample: B-4 **Depth:** 2
■ Source of Sample: B-4 **Depth:** 6

Materials Testing of Arkansas
Little Rock, AR

Remarks:

Figure

Particle Size Distribution Report



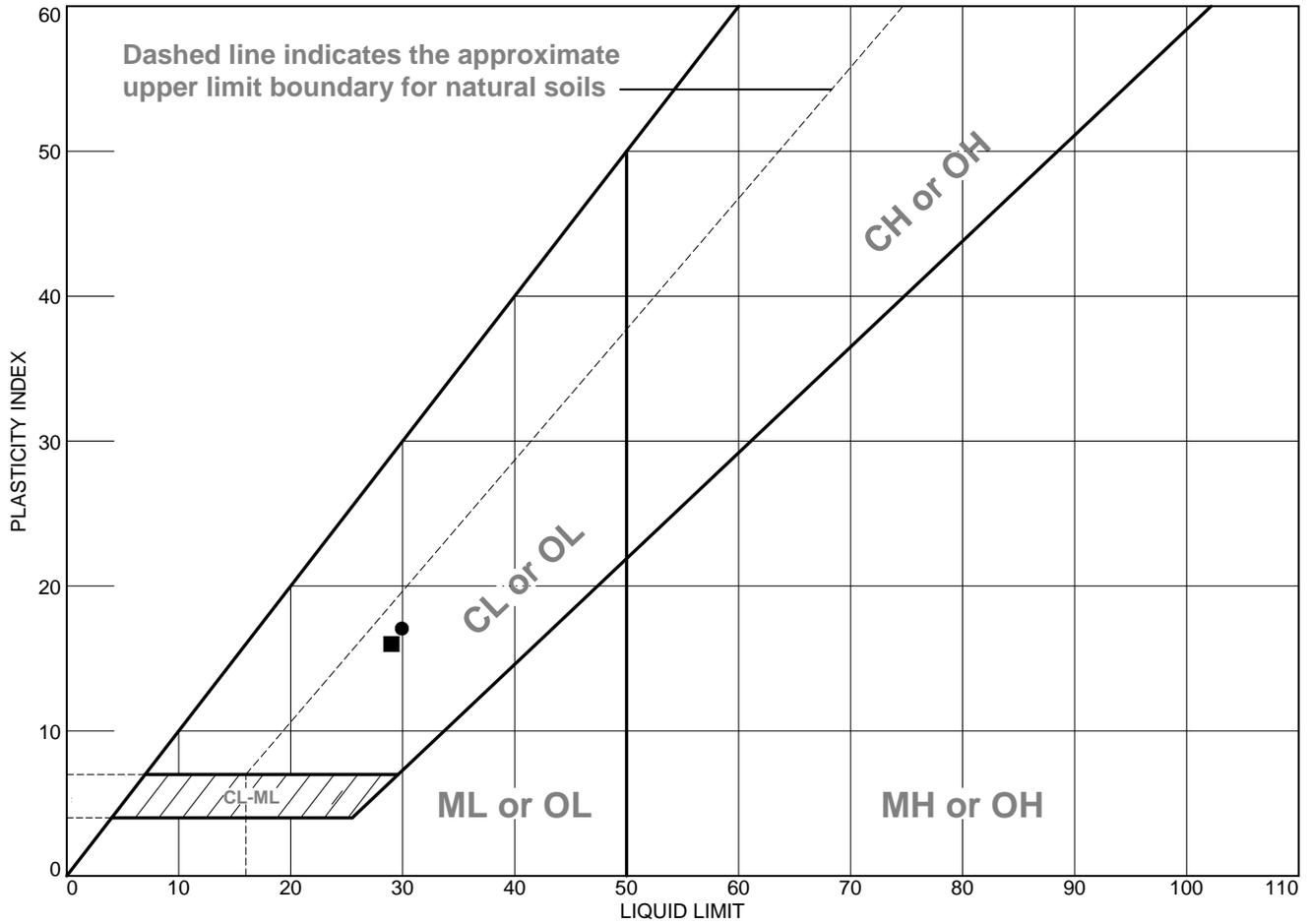
GRAIN SIZE - mm.

	% +3"	% Gravel		% Sand			% Fines			
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay		
○	0.0	0.0	0.0	0.0	0.5	21.3	78.2			
□	0.0	0.0	0.0	0.0	0.3	14.9	84.8			
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
○	33	20	0.1173							
□	69	29	0.0765							

Material Description	USCS	AASHTO
○ BROWN, LEAN CLAY W/ SAND	CL	A-6(9)
□ BROWNISH GRAY, FAT CLAY W/ SAND	CH	A-7-6(38)

<p>Project No. GEO22-373 Client:</p> <p>Project: FIRST COMMUNITY BANK</p> <p>○ Source of Sample: B-4 Depth: 2</p> <p>□ Source of Sample: B-4 Depth: 6</p>	<p>Remarks:</p>
<p>Materials Testing of Arkansas</p> <p>Little Rock, AR</p>	
<p>Figure</p>	

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	BROWN, CLAYEY SAND	30	13	17	92.0	44.6	SC
■	BROWN, CLAYEY SAND	29	13	16	93.4	34.3	SC

Project No. GEO22-373 **Client:**
Project: FIRST COMMUNITY BANK
 ● **Source of Sample:** B-5 **Depth:** 0
 ■ **Source of Sample:** B-5 **Depth:** 13.5

Remarks:

Materials Testing of Arkansas
Little Rock, AR

Figure

Appendix E: Seismic Design Criteria

Search Information

Coordinates: 35.612440925721764, -90.3307970718277

Elevation: 225 ft

Timestamp: 2023-01-30T17:53:34.794Z

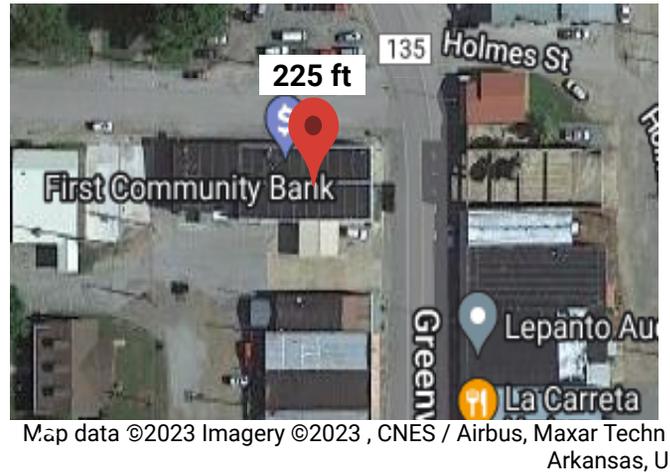
Hazard Type: Seismic

Reference Document: IBC-2015

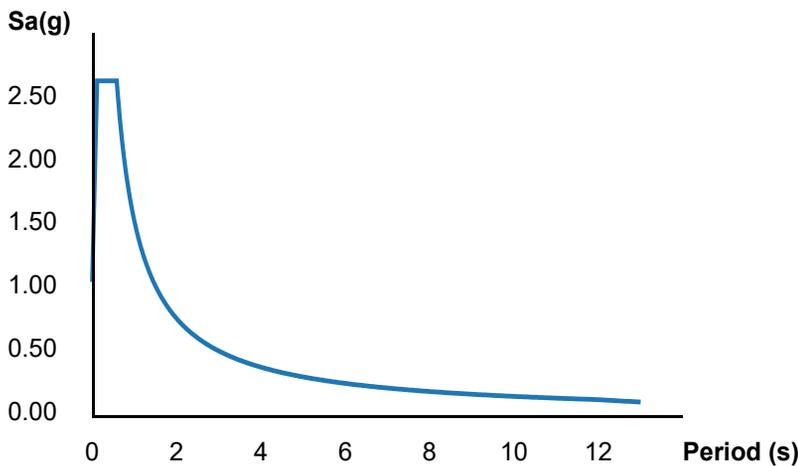
Risk Category: II

Risk Category: D

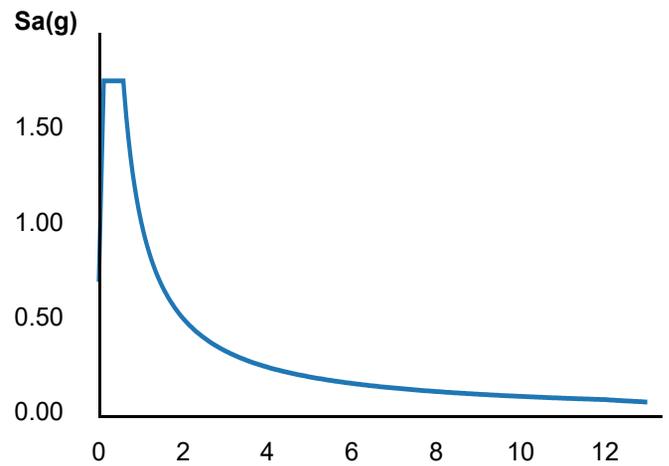
Site Class:



MCE_R Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S _S	2.65	MCE _R ground motion (period=0.2s)
S ₁	1.027	MCE _R ground motion (period=1.0s)
S _{MS}	2.65	Site-modified spectral acceleration value
S _{M1}	1.54	Site-modified spectral acceleration value
S _{DS}	1.767	Numeric seismic design value at 0.2s SA
S _{D1}	1.027	Numeric seismic design value at 1.0s SA

▼Additional Information

Name	Value	Description
SDC	E	Seismic design category
F_a	1	Site amplification factor at 0.2s
F_v	1.5	Site amplification factor at 1.0s
CR_S	0.725	Coefficient of risk (0.2s)
CR_1	0.75	Coefficient of risk (1.0s)
PGA	1.731	MCE_G peak ground acceleration
F_{PGA}	1	Site amplification factor at PGA
PGA_M	1.731	Site modified peak ground acceleration
T_L	12	Long-period transition period (s)
SsRT	2.65	Probabilistic risk-targeted ground motion (0.2s)
SsUH	3.655	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	5.139	Factored deterministic acceleration value (0.2s)
S1RT	1.027	Probabilistic risk-targeted ground motion (1.0s)
S1UH	1.369	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	1.748	Factored deterministic acceleration value (1.0s)
PGAd	2.452	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding design.

Please note that the ATC Hazards by Location website will not be updated to support ASCE 7-22. [Find out why.](#)

Disclaimer

Hazard loads are provided by the U.S. Geological Survey [Seismic Design Web Services](#).

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BID FORM

To: First Community Bank
Mr. Dale Cole

Project: A New Branch Bank for
First Community Bank
202 Greenwood Avenue – Hwy. 135 & Holmes Street
Lepanto, AR

Date:

Submitted by:
(full name and address)

1. OFFER

Having examined the Place of The Work and all matters referred to in the Instructions to Bidders and the Contract Documents prepared by Architect for the above mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Sum of:

\$.....dollars, in lawful money of the United States of America.

We have included, the security Bid Bond as required by the Instruction to Bidders.

All applicable taxes are included in the Bid Sum.

All Cash Allowances described in Section 01 20 00 are included in the Bid Sum.

2. ACCEPTANCE

This offer shall be open to acceptance and is irrevocable for sixty days from the bid closing date.

If this bid is accepted by the Owner within the time period stated above, we will:

- Execute the Agreement within ten days of receipt of Notice of Award.
- Furnish the required bonds and insurance within ten days of receipt of Notice of Award.
- Commence work within ten days after written Notice to Proceed.

If this bid is accepted within the time stated, and we fail to commence the Work, the security deposit shall be forfeited as damages to the Owner by reason of our failure, limited in amount to the lesser of the face value of the security deposit or the difference between this bid and the bid upon which a Contract is signed.

In the event our bid is not accepted within the time stated above, the required security deposit will be returned to the undersigned, in accordance with the provisions of the Instructions to Bidders; unless a mutually satisfactory arrangement is made for its retention and validity for an extended period of time.

3. CONTRACT TIME

If this Bid is accepted, we will:

- Complete the Work in(.....) calendar days from Notice to Proceed.

4. ADDENDA

The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Sum.

Addendum # Dated

Addendum # Dated

Addendum # Dated

Addendum # Dated

Addendum # Dated

Addendum # Dated

5. APPENDICES

The following documents are attached to and made a condition of the Bid:

Bid security in form of

Document 00 43 00 including:

Appendix A - List of Unit Prices.

6. SUBCONTRACTOR LISTING

	Subcontractor	License No.
A. Plumbing
B. Mechanical

C. Electrical

D. Roofing

7. TRENCHING SAFETY SYSTEM

Ark. Code Ann. § 22-9-212 requires the contractor to indicate on this Bid Form the cost of Trenching Safety Systems. ***FAILURE TO SHOW THIS COST WILL INVALIDATE THE BID.*** (NOTE THIS COST SHALL BE INCLUDED IN THE ABOVE BASE BID)

.....
(Dollar Amount Is To Be Shown Numerically)

8. BID FORM SIGNATURES

.....
(Bidder - print the full name of your firm)

.....
(Authorized signing officer)

.....
(License Number)

END OF DOCUMENT

BID FORM SUPPLEMENTS

To: First Community Bank
Mr. Dale Cole

Project: A New Branch Bank for
First Community Bank
202 Greenwood Avenue – Hwy. 135 & Holmes Street
Lepanto, AR

Date:

Submitted by:
(full name and address)

In accordance with Document 00 21 13 and Document 00 41 13, we include the Appendices to Bid Form Supplements listed below. The information provided shall be considered an integral part of the Bid Form.

The following Appendices are attached to this document:

Appendix A - List of Unit Prices: Include listing of unit prices specifically requested by Contract Documents.

BID FORM SUPPLEMENTS SIGNATURES

.....
(Bidder - print the full name of your firm)

.....
(Authorized signing officer)

.....
(License Number)

APPENDIX A - LIST OF UNIT PRICES

The following is the list of unit prices referenced in the bid submitted by:

(Bidder)

To (Owner) First Community Bank, Mr. Dale Cole

Dated and which is an integral part of the Bid Form.

The following are Unit Prices for specific portions of the Work as listed, and are applicable to authorized variations from the Contract Documents.

ITEM DESCRIPTION	UNIT	UNIT VALUE
1. Removal and replacement of unstable soil, compacted in place.	Cu. Yd.	

END OF DOCUMENT

GENERAL CONDITIONS

1.1 SUMMARY

- A. Document Includes: General Conditions.
- B. Related Documents:
 - 1. Document 00 73 13 - Supplementary Conditions.

1.2 GENERAL CONDITIONS

- A. AIA Document A201-2017, General Conditions of the Contract for Construction, is the General Conditions of the Contract. They are hereby incorporated into and made as much a part of this Project Manual as if bound herein. A copy of the General Conditions is on file and may be examined in the Architect's office. The printed General Conditions will be bound in each of the contract copies of the Project Manual to be retained by the Owner, Architect, and Contractor as part of the executed Contract Documents.

1.3 SUPPLEMENTARY CONDITIONS

- A. Refer to Document 00 73 13 for modifications to General Conditions.

END OF DOCUMENT

SUPPLEMENTARY CONDITIONS

1.1 SUMMARY

- A. Document Includes: Supplementary Conditions.
- B. Related Documents:
 - 1. Document 00 72 14 - General Conditions.

1.2 SUPPLEMENTARY CONDITIONS

- A. These Supplementary Conditions modify the General Conditions of the Contract for Construction, AIA Document A201-2017, and other provisions of the Contract Documents as indicated below. All provisions which are not so modified remain in full force and effect.
- B. The terms used in these Supplementary Conditions which are defined in the General Conditions of the Contract for Construction, AIA Document A201-2017, have the meanings assigned to them in the General Conditions.

ARTICLE 1.1 - BASIC DEFINITIONS

Delete subparagraph 1.2.1 and substitute the following:

"1.2.1 The Architect shall identify those Contract Documents which are a part of the Agreement."

ARTICLE 3 - CONTRACTOR

Add subparagraph 3.4.4 under paragraph 3.4 as follows:

"3.4.4 All contractors and subcontractors engaged in the Owner/Contractor Agreement shall conform to the labor laws of the State of Arkansas and the various acts amendatory and supplementary thereto; and to all other laws, ordinances and legal requirements applicable thereto."

Add the following to the end of paragraph 3.5 as follows:

"The Contractor shall guarantee and warrant his and his subcontractors' work and materials (including the materials and work of suppliers of the Contractor and his subcontractors) for a period of one year from the date of acceptance of the project by the Owner. This warranty shall be for a longer period on certain items if so designated in the specifications. The foregoing one-year guaranty and warranty shall not in any way limit, restrict or affect the liability of the Contractor, or his subcontractors, for indemnity as provided for in this Contract, nor shall it in any way shorten the period of limitation fixed by law for the filing of any action against the Contractor for enforcement or for breach of any provisions of the Contract Documents. Should the Contractor elect to use any of the equipment in the building during the construction period,

he shall make arrangements with the subcontractor or supplier of the equipment for any extension of warranty of that equipment made necessary by such use. The warranty period for such equipment to the Owner shall not be reduced by the use of equipment by the Contractor."

Add the following sentence to subparagraph 3.7.1:

"Specifically including the Occupancy Permit."

Add the following sentence to subparagraph 3.9.3:

"The Contractor shall, at all times, enforce strict discipline and good order among his employees and shall not employ on the Work any unfit person or anyone not skilled in the Work assigned to him."

ARTICLE 5 - SUBCONTRACTORS

Add subparagraph 5.2.5 under paragraph 5.2 as follows:

"5.2.5 Where any of the provisions of this paragraph 5.2 conflict with laws of the State of Arkansas, as amended, the provisions of such laws and amendments thereto shall govern."

ARTICLE 7 - CHANGES IN THE WORK

Delete subparagraph 7.3 and substitute the following new paragraph 7.1.4 in lieu thereof:

- "7.1.4 The method used in determining adjustments in the contract sum shall be as follows:
1. Without invalidating the Contract, the Owner may order extra Work or make changes by altering, adding to or deducting from the Work, the contract sum being adjusted accordingly, and with the Contractor obtaining the consent of the surety where necessary or desirable.
 2. No claims for any extra Work or materials shall be allowed unless the Work is ordered in writing by the Architect.
 3. Any changes in the Work will be on a basis of actual cost plus 12% of the cost for overhead and profit, including insurance, for the Contractor performing the Work (subcontractor or General Contractor).
 4. If changes in the Work are performed by a subcontractor, the value of any such Work shall be computed as outlined in subparagraph 3 above, to which the General Contractor may add an overhead and profit charge of six percent (6%), including insurance.
 5. Work omitted that was included in the original Contract shall be computed on the same basis.
 6. The Contractor shall furnish an itemized breakdown for the requested change in Work.
 7. Bills for extras will be allowed only when Work is ordered in writing. No bills based on verbal orders will be allowed unless accompanied by a written order from the Owner.
 8. The Contractor waives all claims for extension of time of completion on account of extra Work, unless application for such extension of time is made by the Contractor in writing within 24 hours of the time such Work is ordered."

ARTICLE 9 - PAYMENTS AND COMPLETION

Delete paragraph 9.3 in its entirety and substitute the following paragraph 9.3 in lieu thereof:

"9.3 APPLICATIONS FOR PAYMENT

- 9.3.1 The Contractor shall present to the Architect an application for payment on or before the twenty-fifth day of each calendar month. These periodical estimates for partial payment shall be submitted on AIA Document G702 and G703.

In preparing estimates, the material delivered and suitably stored on the site and preparatory Work done may be taken into consideration. The Architect shall review the applications for payment in accordance with the general observations of the Work and the percentage of completion of each category before submitting them to the Owner for payment. No later than the 10th day of each calendar month, the Owner will make partial payment to the Contractor, but the Owner will retain 10% of the amount of each such estimate. There shall be retained 10% on the estimated amounts until final completion and acceptance of all Work covered by the Contract. Before issuance of the final certificate, the Contractor shall obtain in writing from the bonding company, approval of such payment. No certificate issued nor payment made to the Contractor, nor partial or entire use or occupancy of the Contract Work by the Owner, shall be an acceptance of any Work or materials not in accordance with this Contract.

- 9.3.2 If approved in advance by the Owner, payment may similarly be made for materials and equipment suitable stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include applicable insurance, storage and transportation to the site for such materials and equipment stored off the site."

ARTICLE 11 - INSURANCE AND BONDS

Delete paragraphs 11.1, 11.2, 11.3, and 11.4, and substitute the new paragraphs 11.1, 11.2, 11.3, and 11.4 as follows:

"11.1 GENERAL

- 11.1.1 The Contractor shall not commence Work under this Contract or allow any subcontractor or anyone directly or indirectly employed by anyone of them, to commence Work until he has obtained all insurance required under this section and duly executed certificates of such insurance have been filed with the Architect and approved by the Owner. All insurance policies, certificates and endorsements shall be submitted to the Architect in duplicate; one copy of which will be retained by the Architect and the other forwarded to the Owner. The Contractor shall require all subcontractors or anyone directly or indirectly

employed by any of them, and anyone for whose acts any of them may be liable, to either obtain statutory Workmen's Compensation, Comprehensive General Liability and Comprehensive Automobile Insurance coverage for his (the subcontractor's) portion of the Work or reimburse the Contractor for providing such insurance coverage. Comprehensive General Liability insurance and Comprehensive Automobile Liability insurance shall protect the Contractor from claims for bodily injury including death to his employees, or of any person other than his employees, and all other claims for property damage including water damage legal liability, personal injury liability, damage from collapse, damage from grading, excavation and all underground work, any and all of which may arise out of or result from the Contractor's operations required for the project, whether such operations be by himself or by any subcontractor or anyone directly employed by either of them.

11.1.2 The required insurance must be written by a company licensed to do business in the State of Arkansas, at the time of the policy issue. In addition, the companies must be acceptable to the Owner.

11.1.3 The Contractor shall not cause any insurance to be canceled nor permit any insurance to lapse. All insurance policies shall contain a clause to the effect that the policy shall not be cancelled or reduced, restricted or limited until fifteen days after the Owner and Architect have received written notice. Certificates of insurance shall contain transcripts from the proper office of the insurer, evidencing in particular, those insured, the extent of the insurance, the location, and the operations to which the insurance applies, the expiration date, and the above mentioned notice of cancellation clause.

11.2 WORKMEN'S COMPENSATION INSURANCE

11.2.1 The Contractor shall procure and maintain during the term of the Contract, Workmen's Compensation Insurance for all his employees engaged at the site of the Work, in accordance with the statutes of the State of Arkansas. In case any hazardous occupations are required for the execution of the Work, which are not covered by the above insurance, special Employer's Liability policy shall be procured and maintained during the term of the Contract by the Contractor to cover workmen engaged in such hazardous occupations.

11.3 LIABILITY AND PROPERTY INSURANCE

11.3.1 Comprehensive General Liability Insurance - The Contractor shall procure and maintain during the term of this Contract, at the Contractor's expense, a comprehensive general liability policy including products/completed operations with limits no less than \$1,000,000 combined single limit or \$500,000 each occurrence and \$1,000,000 aggregate for bodily injury and \$500,000 each occurrence and \$500,000 aggregate for property damage. Contractor shall also furnish umbrella limits of \$1,000,000.

This policy must include "Contractual Coverage" to cover contractual indemnity, and hold harmless the Owner and Architect and all their agents and employees from and against all claims, damages, losses, and expenses, including attorney's fees arising out of or resulting from the performance of the Work, provided such

claim, damage, loss, injury, sickness, disease, death or injury to or destruction of tangible property other than the Work itself, including the loss of use resulting therefrom, and is caused in whole or in part by any negligent act or omission of the Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a part indemnified thereunder. Provide an endorsement to the policy to include the Architect as additional insured.

11.3.2 Comprehensive Automobile Liability Insurance - The Contractor shall procure and maintain during the term of the contract, at the Contractor's expense, comprehensive automobile liability limits not less than \$1,000,000 combined single limit or \$500,000 per person and \$500,000 per accident for bodily injury and \$500,000 limit per accident for property damage. Umbrella liability limits may be used to certify the limits. Provide an endorsement to the policy to include the Architect as additional insured.

11.3.3 Builder's Risk Insurance - The Contractor shall take out and maintain during the life of the Contract and until same has been accepted, Builder's Risk, Fire Extended Coverage, Vandalism, and Malicious Mischief Insurance for an amount equal to 100% of the total value of the Contract sum of the Work. Said insurance coverage to be written in the name of the Contractor and Owner. This insurance shall not be cancelled or reduced upon Substantial Completion of the Project, but shall be kept in force until final acceptance of the Project and final payment is made.

11.4 PERFORMANCE AND PAYMENT BOND

11.4.1 Furnish a Performance and Payment Bond in the amount equal to 100% of the Contract Price, as security for the faithful performance of this Contract and for payment of all indebtedness for labor and materials furnished in connection with this Contract. The bond shall be written by a surety company which has qualified and is authorized to do business in the State of Arkansas and must be executed by a resident local agent who shall be entitled to full commission paid local agents and who is licensed by the Insurance Commissioner to represent the surety company executing said bond and filing with said bond, his power of attorney as his authority. The mere countersigning of a bond will not be sufficient. The bond shall be written in favor of the Owner.

11.4.2 An original and two copies of the bond must be furnished, with power of attorney attached to each. The bond must not be dated prior to the date of the Contract. The Contractor shall file (not record) the original with the Clerk of the Circuit Court of the County in which the Work to be performed is located. The Contractor is to pay all expenses incident to the filing of the bond. The remaining two copies should be certified by the Clerk to evidence the filing of the original and these two copies submitted to the Architect."

ARTICLE 13 - MISCELLANEOUS PROVISIONS

Add paragraph 13.6, "SUBSTITUTIONS", as follows:

"13.6 SUBSTITUTIONS

- 13.6.1 Where a definite material is specified, it is not the intent to discriminate against any equal product of another manufacturer. It is the intent to set a definite standard. Open competition is expected, but in all cases, complete data must be submitted on all proposed substitutes and samples shall be submitted for comparison and test when requested by the Architect. No substitution shall be made unless authorized in writing by the Architect. If the Contractor intends to substitute an equal product, he shall make this fact known, in writing, to the Architect within 30 days after the award of the Contract, including any changes in the Work required to accommodate the substitution.
- 13.6.2 Should a substitution be accepted and should the substitute material prove defective or otherwise unsatisfactory for the service intended and within the guaranty period, the Contractor shall replace this material or equipment with the material or equipment specified by name.
- 13.6.3 After execution of the Contract Agreement, proposed substitutions will be considered only if there is no decrease in quality, and only when submitted by or through the General Contractor. Such requests shall be submitted promptly in order to allow adequate time for checking and study by the Owner and Architect without delaying the project. Requests for time extensions will not be approved for delays due to related substitutions. No substitution will be allowed without the Architect's approval, in writing.

ARTICLE 15 - CLAIMS AND DISPUTES

In subparagraph 15.4.1, after the words, "American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the agreement", add the words, "subject to applicable laws of the state of Arkansas".

END OF DOCUMENT

SECTION 01 10 00

SUMMARY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Contract description.
- B. Work by Owner.
- C. Owner supplied products.

1.2 CONTRACT DESCRIPTION

- A. Work Covered by Contract Documents: Architect's Project #1733, dated February 8, 2023 includes furnishing tools, labor and equipment to perform the work required for a new branch bank for First Community Bank, located at 202 Greenwood Avenue – Highway 135 & Holmes Streets in Lepanto, AR including civil, landscaping, general construction, mechanical and electrical work in accordance with the following:
 - 1. Conditions of Contract: General Conditions, Supplementary Conditions
 - 2. Specifications: Divisions 0, 1, 3 through 12, 14, 22, 23, 26, 27, 28, 31, 32, and 33
 - 3. Drawings:
 - a. Cover Sheet
 - b. General Information Sheet Nos. G1.0, G1.1, G1.2, G1.3
 - c. Civil Sheet Nos. C1.1, C1.2, C1.3, C1.4, C1.5, C5.1, C5.2, C5.3, C5.4
 - d. Landscape Sheet Nos. L1.1, L5.1
 - e. Architectural Sheet Nos. A1.0, A1.1, A1.2, A2.1, A2.2, A3.1, A4.1, A4.2, A4.3, A5.1, A6.1, A6.2, A6.3, A7.1, A8.1, A9.1, A10.1
 - f. Structural Sheet Nos. S1.1, S2.1, S2.2, S2.3, S3.1, S3.2, S3.3, S4.1, S4.2, S4.3, S4.4, S5.1, S5.2, S5.3, S5.4
 - g. Mechanical Sheet Nos. M0.1, M1.1, M1.2, M2.1, M2.2, M3.1
 - h. Plumbing Sheet Nos. P0.1, P1.1, P1.2, P1.3, P2.1, P2.2, P3.1
 - i. Electrical Sheet Nos. E1.1, E2.1, E3.1, E3.2, E4.1
 - 4. Addenda: Any addenda issued during the bidding period and made a part of the Contract Documents.
 - 5. Agreements: Contract Agreement between Owner and Contractor as executed, and mutually agreed upon Bid Modification Documents and change orders issued.

1.3 WORK BY OWNER

- A. Items noted NIC (Not in Contract), will be furnished and installed by Owner beginning Substantial Completion.
- B. Schedule:
 - 1. Furnishings
 - 2. Equipment

3. Data, telecommunications, cable TV, A/V
4. Low voltage cabling
5. Bank equipment
6. Soap dispensers

1.4 OWNER FURNISHED CONTRACTOR INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities:

1. Arrange for and deliver Owner-reviewed Shop Drawings, Product Data, and Samples, to Contractor.
2. Arrange and pay for delivery to site.
3. On delivery, inspect products jointly with Contractor.
4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:

1. Review Owner-reviewed Shop Drawings, Product Data, and Samples.
2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
3. Handle, store, install and finish products.
4. Repair or replace items damaged after receipt.

C. Items furnished by Owner for installation by Contractor:

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cash allowances.
- B. Schedule of values.
- C. Applications for payment.
- D. Change procedures.
- E. Unit prices.
- F. Alternates.

1.2 CASH ALLOWANCES

- A. Costs Included in Cash Allowances: Cost of product to Contractor, less applicable trade discounts; delivery to site and applicable taxes.
- B. Costs Not Included in Cash Allowances but Included in Contract Sum/Price: Product handling at site, including unloading, uncrating, and storage; protection of products from elements and from damage; and labor for installation and finishing.
- C. Architect Responsibilities:
 - 1. Consult with Contractor for consideration and selection of products, suppliers, and installers.
 - 2. Select products in consultation with Owner and transmit decision to Contractor.
 - 3. Prepare Change Order.
- D. Contractor Responsibilities:
 - 1. Assist Architect in selection of products, suppliers and installers.
 - 2. Obtain proposals from suppliers and installers and offer recommendations.
 - 3. On notification of selection by Architect, execute purchase agreement with designated supplier and installer.
 - 4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
 - 5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- E. Differences in costs will be adjusted by Change Order.
- F. Allowances Schedule:
 - 1. Provide an allowance of 1,250 cubic yards for removal and replacement of unsuitable soil. Soil to be compacted and minimum 95 percent maximum Modified Proctor dry density (ASTM D 1557) as required by soils engineer.

2. Provide an allowance for cutting in 15 grommets in countertops. (This includes ALL types of countertops.)
3. Provide an allowance of \$10,000 for costs associated with installation of Owner Furnished generator.

1.3 SCHEDULE OF VALUES

- A. Submit printed schedule on AIA Form G703 - Continuation Sheet for G702.
- B. Submit Schedule of Values in duplicate within 15 days after date established in Notice to Proceed.
- C. Format: Utilize Table of Contents of this Project Manual. Identify each line item with number and title of major specification Section.
- D. Include in each line item, amount of Allowances specified in this section.
- E. Include separately from each line item, direct proportional amount of Contractor's overhead and profit.
- F. Revise schedule to list approved Change Orders, with each Application for Payment.

1.4 APPLICATIONS FOR PAYMENT

- A. Submit each application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702. Submit electronically.
- B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- C. Submit updated construction schedule with each Application for Payment.
- D. Payment Period: Monthly, as stated in the Supplementary Conditions.
- E. Substantiating Data: When Architect requires substantiating information, submit data justifying dollar amounts in question.

1.5 CHANGE PROCEDURES

- A. The Architect will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing a Drawing Clarification.
- B. The Architect may issue a Proposal Request including a detailed description of proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change. Contractor will prepare and submit estimate within 10 days.
- C. Contractor may propose changes by submitting a request for change to Architect, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors.

- D. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's fixed price quotation or Contractor's request for Change Order as approved by Architect.
- E. Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Architect will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.
- F. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.
- G. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
- H. Correlation of Contractor Submittals:
 - 1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
 - 2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
 - 3. Promptly enter changes in Project Record Documents.

1.6 UNIT PRICES

- A. Unit Quantities: Quantities and measurements indicated in Bid Form are for contract purposes only. Actual quantities provided shall determine payment.
- B. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application or installation of item of the Work; overhead and profit.
- C. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Architect multiplied by unit sum/price for Work incorporated in or made necessary by the Work.
- D. Unit Price Schedule:
 - 1. Removal and replacement of unstable soil, compacted in place. Price to be per cubic yard.

1.7 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work.
- C. Schedule of Alternates:
 - 1. Alternate No. 1: Delete raised island, curb, and gutter at entry, on Greenwood Avenue. Replace with two striped islands and two parallel parking spaces similar to those shown on Holmes Street.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coordination and project conditions.
- B. Field engineering.
- C. Preconstruction meeting.
- D. Progress meetings.
- E. Pre-installation meetings.
- F. Cutting and patching.
- G. Special procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.
- B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion, and for portions of Work designated for Owner's partial occupancy.
- F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 FIELD ENGINEERING

- A. Employ Land Surveyor registered at Project location and acceptable to Architect.
- B. Locate and protect survey control and reference points. Promptly notify Architect of discrepancies discovered.
- C. Verify set-backs and easements; confirm drawing dimensions and elevations.
- D. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.
- E. Maintain complete and accurate log of control and survey work as Work progresses.
- F. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- G. Promptly report to Architect loss or destruction of reference point or relocation required because of changes in grades or other reasons.
- H. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

1.4 PRECONSTRUCTION MEETING

- A. Architect will schedule meeting after Notice to Proceed.
- B. Attendance Required: Owner, Architect, major subcontractors, Superintendent, and Contractor.
- C. Agenda:
 - 1. Bonds and insurance.
 - 2. Documents
 - 3. List of subcontractors.
 - 4. Construction schedule.
 - 5. Designation of personnel represented for contact on this job.
 - 6. Procedure for processing field decisions as they relate to proposal requests and finally change orders.
 - a. RFI's, PR's and Change Orders.
 - b. Design questions.
 - 7. Scheduling and reports of geotech.
 - 8. Visits by Owner and contractor to project site.
 - 9. Temporary utilities provided by the Owner.
 - 10. Survey and building layout.
 - 11. Security on site.
 - 12. Application of payment document preference, date, etc.
 - 13. Special Inspections.
 - 14. As built drawings schedule.
 - 15. Protection of in-place equipment and use of before end of construction.
 - 16. Owner furnished items – coordination and installation.
- D. Record minutes and distribute copies within two days after meeting to participants, and those affected by decisions made.

1.5 PROGRESS MEETINGS

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

1.6 PRE-INSTALLATION MEETINGS

- A. When required in individual specification sections, convene pre-installation meetings at Project site prior to commencing work of specific section.
- B. Require attendance of parties directly affecting, or affected by, Work of specific section.
- C. Notify Architect/Engineer one week in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of installation, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with one copy to Architect/Engineer, and those affected by decisions made.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 CUTTING AND PATCHING

- A. Employ skilled and experienced installer to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements affecting:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate contractor.
- C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
 - 1. Fit the several parts together, to integrate with other Work.
 - 2. Uncover Work to install or correct ill-timed Work.
 - 3. Remove and replace defective and non-conforming Work.
 - 4. Remove samples of installed Work for testing.
 - 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute work by methods to avoid damage to other Work, and to provide proper surfaces to receive patching and finishing.
- E. Cut masonry and concrete materials using masonry saw or core drill.
- F. Restore Work with new products in accordance with requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- J. Identify hazardous substances or conditions exposed during the Work to Architect for decision or remedy.

3.2 SPECIAL PROCEDURES

- A. Remove debris from area and from concealed spaces.
- B. Prepare surface and remove surface finishes to permit installation of new work and finishes.
- C. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.

- D. Where change of plane of 1/4 inch or more occurs, submit recommendation for providing smooth transition; to Architect for review
- E. Finish surfaces as specified in individual product sections.

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittal procedures.
- B. Construction progress schedules.
- C. Proposed products list.
- D. Product data.
- E. Shop drawings.
- F. Samples.
- G. Design data.
- H. Test reports.
- I. Certificates.
- J. Manufacturer's instructions.
- K. Manufacturer's field reports.
- L. Construction photographs.

1.2 SUBMITTAL PROCEDURES

- A. Transmit each submittal with AIA Form G810.
- B. Send submittals electronically. Do not submit MSDS sheets or any unnecessary data. Clearly mark products proposed for use. In addition to electronic submittals for structural, send one hard copy.
- C. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- D. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.
- E. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.
- F. Schedule submittals to expedite Project, and deliver to Architect. Coordinate submission of related items.

- G. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.
- H. Submittals may require more than one submission. However, submittals not reviewed by the General Contractor, which require more than one resubmittal, will result in charges levied for time spent reviewing repeated submittals. Charges will be billed to the General Contractor and arrangements must be made for payment before the submittals will be returned. Such unnecessary extensions of time cannot be used to extend the contract time.
- I. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of completed Work.
- J. Allow space on submittals for Contractor and Architect/Engineer review stamps.
- K. When revised for resubmission, identify changes made since previous submission. The complete submittal will not be reviewed again, only the items marked. Architect/Engineer will not be responsible for any other changes to previously accepted items.
- L. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
- M. Submittals not requested will not be recognized or processed.

1.3 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial schedules within 15 days after date of Owner-Contractor Agreement.
- B. Submit revised Progress Schedules with each Application for Payment.
- C. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.
- D. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.
- E. Submit computer generated horizontal bar chart with separate line for each major portion of Work or operation, = identifying first work day of each week.
- F. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.
- G. Indicate estimated percentage of completion for each item of Work at each submission.
- H. Submit separate schedule of submittal dates for shop drawings, product data, and samples, including Owner furnished products, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
- I. Indicate delivery dates for Owner furnished products.
- J. Revisions to Schedules:

1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect including effect of changes on schedules of separate contractors.

1.4 PROPOSED PRODUCTS LIST

- A. Within 15 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.5 PRODUCT DATA

- A. Product Data: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Submit electronically.
- C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- E. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.6 SHOP DRAWINGS

- A. Any drawings provided by the Architect or Engineer to be used in the preparation of shop drawings will be at the cost of \$100 per sheet.
- B. Shop Drawings: Submit to Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- C. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. When required by individual specification sections, provide shop drawings signed and sealed by professional engineer responsible for designing components shown on shop drawings.
 1. Include signed and sealed calculations to support design.

2. Submit drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- E. Submit one hard copy structural submittals that include drawings. All other submittals may be submitted electronically.
- F. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.7 SAMPLES

- A. Samples: Submit to Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Samples For Selection as Specified in Product Sections:
1. Submit to Architect for aesthetic, color, or finish selection.
 2. Submit samples of finishes in colors selected.
- C. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- D. Include identification on each sample, with full Project information.
- E. Submit number of samples specified in individual specification sections; Architect will retain one sample.
- F. Reviewed samples which may be used in the Work are indicated in individual specification sections.
- G. Samples will not be used for testing purposes unless specifically stated in specification section.
- H. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01 70 00 - Execution and Closeout Requirements.

1.8 DESIGN DATA

- A. Submit for Architect's knowledge as contract administrator or for Owner.
- B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.9 TEST REPORTS

- A. Submit for Architect's knowledge as contract administrator or for Owner.

- B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.10 CERTIFICATES

- A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect.

1.11 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect for delivery to Owner in quantities specified for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.12 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for Architect/Engineer's benefit as contract administrator or for Owner.
- B. Submit report within 5 days of observation to Architect for information.
- C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.13 CONSTRUCTION PHOTOGRAPHS

- A. Provide photographs of site and construction throughout progress of Work.
- B. Twice monthly submit photographs with Application for Payment.
- C. Identify each print on back. Identify name of Project, orientation of view, date and time of view.
- D. Deliver negatives to Owner with project record documents. Catalog and index negatives in chronological sequence; include typed table of contents.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Superintendent.
- B. Quality control and control of installation.
- C. Tolerances.
- D. References.
- E. Labeling.
- F. Mock-up requirements.
- G. Testing and inspection services.
- H. Manufacturers' field services.
- I. Examination.
- J. Preparation.

1.2 SUPERINTENDENT

- A. The Superintendent assigned to this project must be competent and satisfactory to the Architect.
- B. Do not change superintendents except with the consent of the Architect, unless he proves to be unsatisfactory, or ceases to be in his employ.

1.3 QUALITY CONTROL AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. When manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce required and specified quality.

- F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.4 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.5 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.6 LABELING

- A. Attach label from agency approved by authority having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label.
 - 1. Model number.
 - 2. Serial number.
 - 3. Performance characteristics.

1.7 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this section and identified in respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

- C. Accepted mock-ups shall be comparison standard for remaining Work.
- D. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Architect/Engineer.

1.8 TESTING AND INSPECTION SERVICES

- A. Employ and pay for services of an independent testing agency or laboratory acceptable to Owner to perform specified testing.
 - 1. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of deficiencies reported by inspection.
- B. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Architect.
 - 1. Laboratory: Authorized to operate at Project location.
 - 2. Laboratory Staff: Maintain full time registered Engineer on staff to review services.
 - 3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.
- C. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Architect or Owner. Refer also to Section 01 40 10 for Special Inspections.
- D. Reports will be submitted by independent firm to Architect and Contractor, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
 - 1. Submit final report indicating correction of Work previously reported as non-compliant.
- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Architect and independent firm 2 weeks prior to expected time for operations requiring services.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- F. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- G. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Architect/Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

- H. Agency Responsibilities:
 - 1. Test samples of mixes submitted by Contractor.
 - 2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 3. Perform specified sampling and testing of products in accordance with specified standards.
 - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 5. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
 - 6. Perform additional tests required by Architect.
 - 7. Attend preconstruction meetings and progress meetings.

- I. Agency Reports: After each test, promptly submit four copies of report to Architect, Contractor, and authority having jurisdiction. When requested by Architect, provide interpretation of test results. Include the following:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name of inspector.
 - 4. Date and time of sampling or inspection.
 - 5. Identification of product and specifications section.
 - 6. Location in Project.
 - 7. Type of inspection or test.
 - 8. Date of test.
 - 9. Results of tests.
 - 10. Conformance with Contract Documents.

- J. Limits on Testing Authority:
 - 1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency or laboratory may not approve or accept any portion of the Work.
 - 3. Agency or laboratory may not assume duties of Contractor.
 - 4. Agency or laboratory has no authority to stop the Work.

1.9 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, and test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.

- B. Submit qualifications of observer to Architect 2 weeks in advance of required observations.

- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

- D. Refer to Section 01 33 00 - Submittal Procedures, MANUFACTURERS' FIELD REPORTS article.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.
- D. Beginning of Work constitutes acceptance of substrate and conditions.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary Utilities:
 - 1. Temporary electricity.
 - 2. Temporary lighting for construction purposes.
 - 3. Temporary heating.
 - 4. Temporary cooling.
 - 5. Temporary ventilation.
 - 6. Telephone service.
 - 7. Temporary water service.
 - 8. Temporary sanitary facilities.

- B. Construction Facilities:
 - 1. Field offices and sheds.
 - 2. Vehicular access.
 - 3. Parking.
 - 4. Progress cleaning and waste removal.
 - 5. Project identification.
 - 6. Fire prevention facilities.

- C. Temporary Controls:
 - 1. Barriers.
 - 2. Enclosures and fencing.
 - 3. Security.
 - 4. Water control.
 - 5. Dust control.
 - 6. Erosion and sediment control.
 - 7. Noise control.
 - 8. Pollution control.

- D. Removal of utilities, facilities, and controls.

1.2 TEMPORARY ELECTRICITY

- A. Provide and pay for power service required from utility source as needed for construction operation. Refer to electrical specifications for additional requirements.

- B. Provide power outlets, with branch wiring and distribution boxes located as required for construction operations. Provide flexible power cords as required for portable construction tools and equipment.

- C. Permanent convenience receptacles may be utilized during construction.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain lighting for construction operations and to exterior staging and storage areas after dark for security purposes.
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps for specified lighting levels.
- C. Maintain lighting and provide routine repairs.
- D. Permanent building lighting may be utilized during construction.

1.4 TEMPORARY HEATING

- A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.
- B. Prior to operation of permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.
- C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in product sections.

1.5 TEMPORARY COOLING

- A. Provide and pay for cooling devices and cooling as needed to maintain specified conditions for construction operations.
- B. Prior to operation of permanent equipment for temporary cooling purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.
- C. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

1.6 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.7 TELEPHONE SERVICE

- A. Provide, maintain, and pay for telephone service to field office at time of project mobilization.

1.8 TEMPORARY WATER SERVICE

- A. Provide and pay for suitable quality water service as needed to maintain specified conditions for construction operations.

- B. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

1.9 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of project mobilization.

1.10 FIELD OFFICES AND SHEDS

- A. Office: Weather tight, with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. When permanent facilities are enclosed with operable utilities, relocate offices and storage into building, with written agreement of Owner, and remove temporary buildings.
- D. Storage Spaces: Heating and ventilation as needed to maintain products in accordance with Contract Documents; lighting for maintenance and inspection of products.
- E. Storage Areas and Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 01 60 00 - Product Requirements.
- F. Preparation: Fill and grade sites for temporary structures sloped for drainage away from buildings.
- G. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

1.11 VEHICULAR ACCESS

- A. Construct temporary access roads from public thoroughfares to serve construction area, of width and load bearing capacity to accommodate unimpeded traffic for construction purposes.
- B. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.
- C. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.
- D. Provide unimpeded access for emergency vehicles.
- E. Provide and maintain access to fire hydrants and control valves free of obstructions.
- F. Provide means of removing mud from vehicle wheels before entering streets.

1.12 PARKING

- A. Provide surface parking areas to accommodate construction personnel.

- B. When site space is not adequate, provide additional off-site parking.
- C. Use of existing on-site streets and driveways, and parking areas used for construction traffic is not permitted.
- D. Do not allow heavy vehicles or construction equipment in parking areas.
- E. Permanent Pavements and Parking Facilities:
 1. Prior to Substantial Completion, bases for permanent roads and parking areas may be used for construction traffic.
 2. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.
 3. Use of permanent parking structures is permitted.
- F. Maintenance:
 1. Maintain traffic and parking areas in sound condition, free of excavated material, construction equipment, products, mud, snow, and ice.
 2. Maintain paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.
- G. Removal, Repair:
 1. Remove temporary materials and construction at Substantial Completion.
 2. Remove underground work and compacted materials to depth of 2 feet; fill and grade site as specified.
 3. Repair facilities damaged by use, to specified condition.
- H. Mud from Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.13 PROGRESS CLEANING AND WASTE REMOVAL

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

1.14 PROJECT IDENTIFICATION

- A. Project Identification Sign: Erect sign identifying project, GC and any other pertinent information.

- B. Installation:
 - 1. Install project identification sign within 15 days after date fixed by Notice to Proceed.
 - 2. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
 - 3. Install sign surface plumb and level, with butt joints. Anchor securely.
- C. Maintenance: Maintain signs and supports clean, repair deterioration and damage.
- D. Removal: Remove signs, framing, supports, and foundations at completion of Project and restore area.

1.15 FIRE PREVENTION FACILITIES

- A. Prohibit smoking with buildings under construction and demolition. Designate area on site where smoking is permitted. Provide approved ashtrays in designated smoking areas.
- B. Establish fire watch for cutting and welding and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.
- C. Portable Fire Extinguishers: NFPA 10; 10 pound capacity, 4A-60B: C UL rating.
 - 1. Provide one fire extinguisher at building under construction and demolition.
 - 2. Provide minimum one fire extinguisher in every construction trailer and storage shed.
 - 3. Provide minimum one fire extinguisher on roof during roofing operations using heat producing equipment.

1.16 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way.
- C. Provide protection for plants designated to remain. Replace damaged plants.

1.17 ENCLOSURES AND FENCING

- A. Construction: Contractor's option.
- B. Exterior Enclosures: Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.
- C. Interior Enclosures: Provide temporary partitions as indicated on Drawings to prevent penetration of dust and moisture, and to prevent damage to existing materials and equipment.

1.18 SECURITY

- A. Security Program: Protect operations from theft, vandalism, and unauthorized entry.
- B. Entry Control:
 - 1. Restrict entrance of persons and vehicles into Project site.
 - 2. Allow entrance only to authorized persons with proper identification.
 - 3. Maintain log of workers and visitors, make available to Owner on request.

1.19 WATER CONTROL

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water.

1.20 DUST CONTROL

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

1.21 EROSION AND SEDIMENT CONTROL

- A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation. Refer also to requirements stated in Civil Drawing and specifications.
- B. Minimize surface area of bare soil exposed at one time.
- C. Provide temporary measures including berms, dikes, and drains, and other devices to prevent water flow.
- D. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
- E. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

1.22 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise from construction operations.

1.23 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.
- B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

1.24 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.
- B. Remove underground installations to minimum depth of 2 feet. Grade site as indicated on Drawings.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.
- E. Product substitution procedures.

1.2 PRODUCTS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
- B. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products in accordance with manufacturers' instructions.
- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- D. For exterior storage of fabricated products, place on sloped supports above ground.
- E. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

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

1.6 PRODUCT SUBSTITUTION PROCEDURES

- A. Architect will consider requests for Substitutions only within 30 days after date of Owner-Contractor Agreement. Substitutions will only be allowed if proposed product matches or exceeds quality, and has same appearance as specified product.
- B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse Owner and Architect for review or redesign services associated with re-approval by authorities having jurisdiction.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- F. Substitution Submittal Procedure:
 - 1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - 2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.

3. Architect will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Starting of systems.
- D. Demonstration and instructions.
- E. Testing, adjusting and balancing.
- F. Protecting installed construction.
- G. Substantial Completion.
- H. Project record documents.
- I. Operation and maintenance data.
- J. Manual for materials and finishes.
- K. Manual for equipment and systems.
- L. Spare parts and maintenance products.
- M. Product warranties and product bonds.
- N. Maintenance service.

1.2 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect's review.
- B. Provide submittals to Architect required by authorities having jurisdiction.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.

- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
- D. Replace filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.4 STARTING OF SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect seven days prior to start-up of each item.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractors' personnel in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with Section 01 33 00 - Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of final inspection.
- B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- C. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

- D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
- E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.6 TESTING, ADJUSTING AND BALANCING

- A. Reports will be submitted by independent firm to Architect/Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

1.7 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

1.8 SUBSTANTIAL COMPLETION

- A. Notify the Architect when the Work is considered to be substantially complete. Within a reasonable time after such notification, the Architect will examine the Work to determine the status of completion.
- B. When the Architect determines that the Work is substantially complete, he will conduct a punch list observation and prepare a certificate of substantial completion accompanied by a list of the items to be completed or corrected. Architect will submit the certificate to the Owner and Contractor for their signatures.
- C. Should the Architect determine that the Work is not substantially complete, he will promptly notify the Contractor, giving reasons therefore. Contractor shall remedy the deficiencies in the Work and contact Architect to re-examine.
- D. The Architect reserves the right to add items to the punch list found during punch list check-off.

1.9 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, Product Data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Details not on original Contract drawings.
- G. Submit three thumbdrives to Architect with claim for final Application for Payment.

1.10 OPERATION AND MAINTENANCE DATA

- A. Submit in thumbdrive format.
- B. Prepare printed title sheet "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project.
- C. Internally subdivide contents with dividers, logically organized as described below.
- D. Drawings: Include in CD.
- E. Contents: Prepare Table of Contents for each system, with each product or system description identified, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Engineers, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 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. Identify the following:

- a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
3. Part 3: Project documents and certificates, including the following:
- a. Shop drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Photocopies of warranties.

1.11 MANUAL FOR MATERIALS AND FINISHES

- A. Submit two thumbdrives of completed data 15 days prior to final inspection.
- B. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations.
- C. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- D. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.
- E. Additional Requirements: As specified in individual product specification sections.
- F. Include listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.12 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit two copies of CDs 15 days prior to final inspection.
- B. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Include color coded wiring diagrams as installed.
- E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and special operating instructions.

- F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- G. Include servicing and lubrication schedule, and list of lubricants required.
- H. Include manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by controls manufacturer.
- J. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Include control diagrams by controls manufacturer as installed.
- L. Include Contractor's coordination drawings, with color coded piping diagrams as installed.
- M. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- N. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- O. Include test and balancing reports as specified in Section 01 40 00 - Quality Requirements.
- P. Additional Requirements: As specified in individual product specification sections.
- Q. Include listing in Table of Contents for design data.

1.13 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.
- B. Deliver to Project site and place in location as directed by Owner; obtain receipt prior to final payment.

1.14 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
- B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.
- C. Verify documents are in proper form, contain full information, and are notarized.
- D. Co-execute submittals when required.
- E. Include Table of Contents in thumbdrives.

- F. Submit prior to final Application for Payment.
- G. Time of Submittals:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
 - 2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.15 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components indicated in specification sections.
- B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.
- D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 031000

CONCRETE FORMS

PART 1 – GENERAL

- 1.1 **GENERAL CONDITIONS:** All work under this section is subject to the General Conditions and Supplementary General Conditions and shall be governed by the requirements therein.
- 1.2 **COOPERATION:** This Contractor is cautioned to examine all drawings and specifications relating to other branches of the work, and he shall make proper provisions to receive all other work.
- 1.3 **SCOPE:** Shall include all formwork and related items required to complete the work indicated on the drawings and/or specified herein.
- 1.4 **DESIGN OF FORMWORK:** Design and engineering of formwork, as well as its construction shall be the responsibility of the Contractor and shall comply with chapters 2 and 3 of ACI-347, and applicable requirements of the controlling local building code.
- 1.5 **NOTICE FOR OBSERVATION BY ENGINEER:** The Contractor shall give the Engineer advance notice, 72 hours before excavations or formwork will be ready to be observed by Engineer. The Contractor shall also give a 24-hour second notice before excavations or formwork, including reinforcing steel and any other built-in material or equipment, are complete and ready to be observed by Engineer.

PART 2 - MATERIALS

- 2.1 Form material shall be B-B Plyform EXT DFPA for surfaces not exposed to view.
- 2.2 Form material shall be HDO EXT-DFPA, high-density overlay plywood for exposed architectural concrete.
- 2.3 Commercially manufactured steel forms are acceptable.
- 2.4 Form ties shall have plastic cones to facilitate patching.
- 2.5 Form accessories to be partially or wholly embedded in concrete, such as ties and hangers, shall be commercially manufactured type. Wire is not acceptable. Portion remaining within concrete shall leave no metal within one inch of surface when concrete is exposed to view. Spreader cones on ties shall not exceed one-inch diameter. All form accessories to be used in concrete having a face exposed to weather shall be galvanized.
- 2.6 Void Form. Fiberboard void forms as manufactured by Savway Carton Form, Inc., 1266 Profit Dr., Dallas, TX 75247, or equal shall be provided under all free spanning grade beams and structural slabs and locations shown on plan. Store in dry place. Install according to manufacturer's instructions.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. At contraction, expansion and construction joints, including keyways, neatly joint forms and securely set to exact grade and alignment. Provide sufficient rigidity and strength to resist pressure of concrete without springing, deflecting, or settling.
- B. Accurately set edge forms and intermediate screed strips to produce designed elevations and contours in finished surface. Forms shall be sufficiently strong to support vibrating bridge screed or roller pipe screeds if nature of finish specified requires use of such equipment. Align concrete surface to contours of screed strips by use of strike-off templates or approved compacting type screeds.
- C. Positive means of adjustment (wedges or jacks) of shores and struts shall be provided and all settlement shall be taken up during concrete placing operation. They shall be securely braced against lateral deflections.

3.2 TOLERANCES: Construct formwork so as to insure that concrete surfaces will conform to tolerances of Section 2.4.1, ACI 347.

3.3 PREPARATION OF FORM SURFACES

- A. Forms shall be sufficiently tight to prevent leakage of grout or cement paste. Board forms having joints opened by shrinkage of wood shall be swelled until closed by wetting before concrete is placed.
- B. Seal plywood and other wood surfaces subject to shrinkage against absorption of moisture from concrete by either a field applied commercial form oil or sealer or a factory applied non-absorptive liner.
- C. When steel forms are coated to prevent bond with concrete, it shall be done prior to placing of reinforcement. Excess material shall not be allowed to come in contact with concrete against which fresh concrete will be placed.
- D. Clean all form surfaces before re-use.

3.4 REMOVAL OF FORMS

- A. Formwork for columns, walls, sides of beams and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal operations.
- B. Formwork for beam soffits and slabs and other parts that support weight of concrete shall remain in place until concrete has reached its specified 28-day strength, unless otherwise specified or permitted by the Engineer.
- C. When shores and other vertical supports are so arranged that form facing material may be removed without loosening or disturbing shores and support, facing material may be removed at an earlier age as specified or permitted. Shores and supports shall remain in place until concrete has reached its specified 28-day strength, unless otherwise specified or permitted.

- D. Whenever formwork is removed during curing period, exposed concrete shall be cured by one of methods specified in Section 033000.
- E. Void forms shall be left in place.

END OF SECTION

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1-GENERAL

- 1.1 SUMMARY: Cast-in-place concrete work, complete, unless otherwise specified. Provide reinforcing steel, dowels, chairs, and accessories as specified for concrete work.
- 1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS
- A. Excavation and filling for sitework, concrete paving; Division 2.
 - B. Excavation and filling for structure; Section 022220.
 - C. Soil treatment for termite control; Section 022800
- 1.3 SUBMITTALS: Comply with Section 013000.
- A. Product Data: Submit manufacturer's product data for reinforcement and forming accessories, admixtures, patching compounds, curing compounds, and other as requested by Engineer.
 - B. Shop Drawings: Submit, prior to installation, shop drawings of reinforcing steel, included bar cutting lists, typical bar bend diagrams, construction of forms including jointing, reveals, locations and pattern of form tie placement, and construction joint schedule with details.
 - C. Design Mix: Prior to placement of concrete, submit concrete mix designs proposed by the concrete supplier, for class of concrete and slump ranges, including recent confirmatory test results substantiating the quality of concrete produced by each mix.
 - D. Reports: Weekly reports of all compression, slump, and air content tests from the testing laboratory.
- 1.4 QUALITY ASSURANCE
- A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are indicated or specified, and except as accepted or directed by Engineer during unusual climatic conditions.
 - 1. ACI 301 "Specifications for Structural Concrete for Building"
 - 2. ACI 318 "Building Code Requirements for Reinforced Concrete"
 - 3. CRSI "Manual of Standard Practice"
 - B. Local Codes and Ordinances: Wherever provisions of the Standard Building Code or the local current ordinances are more stringent than the above specifications and standards, the local codes and ordinances shall govern.
 - C. Concrete Testing Service: Contractor shall engage a testing laboratory to perform material evaluation tests and to design concrete mixes.
 - 1. Tests, including retesting of rejected materials for installed work,

shall be paid for by the contractor. Testing requirements are specified in FIELD SAMPLING AND TESTING paragraph.

PART 2-PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces.
- B. Forms for Unexposed Finish Concrete: Use Plywood, lumber, metal or other acceptable material. If lumber is used, it must be dressed on a least 2 edges and 2 sides for a tight fit.
- C. Form Coatings: Commercial formulation form coating compound with maximum VOC of 350 mg/l that will not bond with, stain, nor adversely affect concrete surfaces, will not impair subsequent treatments of concrete surfaces.
- D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spilling concrete upon removal. Provide units that will leave no metal closer than 1-1/2" to exposed surface.
 - 1. Provide ties that, when removed, will leave holes no larger than 1" diameter in concrete surface.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615 (S1), Grade 60, deformed billet steel bars of grades indicated on structural drawings, free from loose rust, scale and other coatings that may reduce bond.
- B. Mesh or Fabric Reinforcement ASTM A 185, welded wire fabric, of sizes and types as indicated on drawings.
- C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices necessary for properly spacing, supporting, and fastening reinforcement in place.
 - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).
 - 3. For footings, support-reinforcing steel with wire, metal chairs, bolters or other approved device; do not use bricks or stones.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type 1

- B. Normal Weight Concrete Aggregates: ASTM C 33, and as specified. Provide aggregates from a single source for exposed concrete.
1. Fine Aggregate: Clean, sharp, natural or manufactured sand, free from loam, clay, lumps, or other deleterious substances.
 2. Coarse Aggregate: Clean, uncoated, processed, locally available aggregate, containing no clay, mud, loam or foreign matter; maximum size of 1 ½" in foundations and 1" in slabs.
- C. Water: Potable
- D. Admixtures:
1. Air Entrained Admixture: ASTM C 260
 2. Other Admixtures: Do not use other admixtures unless accepted by Engineer; added chlorides will not be accepted.
- E. Miscellaneous Materials:
1. Connectors: Provide metal connectors required for placement in cast-in-place concrete, for the attachment of structural and non-structural members.
 2. Vapor Barrier: Polyethylene, film, 0.010" thick (minimum .02656 lbs. per sq. ft. and $5.71 \pm 3\%$ per 20' X 100' roll); Visqueen or approved equal.
 3. Expansion Joint Filler: ASTM D 1751, non-extruding premoulded material, ½" thick, unless otherwise noted, composed or fiberboard impregnated with asphalt.
 4. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd. complying with AASHTO M 182, Class 2.
 5. Moisture-Retaining Cover: One of the following, complying with ASTM C 171; waterproof paper, polyethylene film, polyethylene-coated burlap.
 6. Liquid Membrane-Forming Curing Compound: ASTM C 309, Type I, Class A. Moisture loss not more than 0.055 gr./sq. cm. When applied at 200 sq. ft./gal. Conspec "Cure & Seal," L & M "Dress & Seal," Sonneborn "Kure-N-Seal," Euclid "Eurocure," Master Builders "Masketkure," W. R. Meadows "Sealight CS-309," or approved equal.
 7. Non-Shrink Grout: CRO-C 621, factory pre-mixed grout
 - a. Non-Metallic Shrinkage-Resistant Grout: Conspec "100 Non-Shrink Grout (Non-Metallic)," Euclid "Euco N.S.," L & N "Crystex," Master Builders "Masterflow 713," W.R. Meadows "Sealight CG-86 Grout," or approved equal.
 8. Bonding-Agent: Polyvinyl acetate or acrylic base

- a. Polyvinyl Acetate (Interior Only): Euclid "Euco Weld," L & M "Everweld," or approved equal.
 - b. Acrylic or Styrene Butadiene: Conspec "Strongbond," Euclid "SBR Latex," L & M "Everbond," Master Builders "Acryl-Set," Sonneborn "Sonocrete," or approved equal.
9. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit project requirements.
- a. Conspec "Spec-Bond 100," Euclid "Euco Epoxy System #452 or #620," L & M "Epabond," Master Builders "Concrete Standard Liquid," or approved equal.
10. Concrete Sealer: R. Meadows "Sealtight Acrylic Concrete Sealer," Sonneborn "Son-No-Mar," Euclid "Eucopoxy I" L & M "Super Seal #35," or approved equal.

2.4 PROPORTIONING OF MIXES

- A. Concrete minimum ultimate strength at 28 days; refer to structural drawings.
- B. Mix Designs:
 - 1. Prepare design mixes for each type of concrete, in accordance with ACI 301 and ACI 318.
 - 2. Proportion design mixes by weight for class of concrete required, complying with ACI 211.
- C. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as approved by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and approved by Engineer before using in work.
- D. Provide test results from the concrete supplier for proposed design mix, to establish the following:
 - 1. Gross weight and yield per cu. Yd of trial mixtures.
 - 2. Measured slump and water/cement ratio
 - 3. Measured air content
 - 4. Compressive strength developed at 7 days and 28 days, from not less than 3 test cylinders cast for each 7 and 28-day test, and for each design mix.
- E. Submit written reports to Engineer for design mixes at least 15 calendar days prior to the start of work.

- 2.5 ADMIXTURES: Use air-entrained admixture in strict compliance with manufacturer's directions at all concrete exposed to weather.

- 2.6 SLUMP LIMITS: 4" to \pm 1" unless noted otherwise
- 2.7 BATCHING AND MIXING: Concrete may be ready-mixed at the Contractor's option, in accordance with the governing building code and with the referenced ACI 318. No hand mixing allowed.
- A. Job-Site Mixing:
1. Mix materials for concrete in appropriate drum-type batch machine mixer. For mixers of one cu. Yd. or smaller capacity, continue mixing at least 1-1/2 minutes, but no more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cu. yd. or fraction thereof.
 2. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
- B. Ready-Mix Concrete:
1. Comply with requirements of ASTM C 94, and as specified.
 2. When air temperature is between 85 degrees F and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3-EXECUTION

- 3.1 FORM WORK
- A. Coordinate installation of joint materials, vapor barrier/retarder, and other related materials with placement of forms and reinforcing steel.
- B. Design, erect, support, brace, and maintain formwork to support vertical and lateral loads, and static and dynamic loads that might be applied until such loads can be supported by the concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment elevations, and position.
- C. Construct forms in accordance with ACI 347, to sizes, shapes, lines and dimensions indicated, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, molding, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
- D. Fabricate forms for easy removal without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.

- E. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous location.
- F. Chamfer exposed comers and edges $\frac{3}{4}$ " unless otherwise indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- G. Preparation of Form Surfaces: Coat the contact surfaces of forms with a form-coating compound where applicable before reinforcement is placed.
- H. Provisions of Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such ties. Accurately place and securely support items built in to form.
- I. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms after concrete placement, if required, to eliminate mortar leaks.

3.2 VAPOR BARRIER INSTALLATION

- A. Following leveling and tamping of granular base for slabs-on-grade, place vapor barrier sheeting in position with longest dimension parallel with direction of pour.
- B. Lap joints 6" and seal with manufacturer's recommended mastic or pressure-sensitive tape.

3.3 PLACING REINFORCEMENT

- A. Comply with the Concrete Reinforcing Steel Institute (CRSI) recommended practice for "Placing Reinforcing Bars" for details and methods of reinforcement placement and supports, and as herein specified.
 - 1. Avoid cutting or puncturing vapor barriers during reinforcement placement and concreting operations.
- B. Clean reinforcement of loose rust, mill scale, dirt, and other materials or coatings, which reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement, against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as required.
- D. Place reinforcement to obtain minimum coverage's indicated, or in not indicated, in compliance with CRSI. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

- E. Do not place bars more than 2" beyond the last leg of continuous support. Do not use supports to hold runways for conveying equipment.
- F. Install mesh welded wire fabric reinforcement in as long lengths as practicable, lapping pieces at least one mesh plus 2" but in no case less than 8." Lace splices with wire. Offset end laps to prevent continuous laps in either direction. Lift mesh to middle third of slab by use of hooks.

3.4 JOINTS AND INSERTS

- A. Joints: Provide construction and expansion joints. Locate and install joints, which are not shown on the drawings, so as not to impair the strength and appearance of structure. Submit joint schedule and details to Architect.
- B. Inserts: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, concrete. Properly located embedded items in cooperation with other trades, and secure in position before concrete is poured. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

3.5 PREPARATION OF FORM SURFACES: Coat contact surfaces of forms with an approved no residual, low-VOC, form-coating compound before reinforcement is placed. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.6 CONCRETE PLACEMENT

- A. Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.
- B. Pre-Placement Inspection: Before placing concrete, clean and inspect formwork, reinforcing steel, and items to be embedded or cast-in. Notify other crafts in ample time to permit the installation of their work, and cooperate with them in setting such work, as required. Make sure soil treatment for termite control has been applied to cushion fill before vapor barrier and concrete are installed. Coordinate the installation of joint materials and vapor barriers with placement of forms and reinforcing steel.
- C. Notify Engineer 48 hours before placing any concrete.
- D. Conveying: Convey concrete from the mixer to the place of final deposit by methods, which will prevent the separation or loss of materials. Provide equipment for chuting, pumping, and pneumatically conveying concrete of proper size and design as to insure a practically continuous flow of concrete at the point of delivery and without segregation of the materials. Keep open troughs and chutes clean and free from coatings of hardened concrete. Do not allow concrete to drop freely more than 10 feet. All equipment and methods used for conveying are subject to the approval of Engineer.

- E. **Depositing:** Deposit concrete continuously or in layers of such thickness that no concrete will be placed on hardened concrete so as to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete near or in its final location to avoid segregation due to rehandling or flowing, and displacement of the reinforcement.

- F. **Placing Concrete in Forms:** Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
 - 1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

- G. **Placing Concrete Slabs:** Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
 - 1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

 - 2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or derbies to smooth surface, free of humps and hollows. Do not disturb slab surfaces prior to beginning finishing operations.

 - 3. Maintain reinforcing in proper position during concrete placement.

- H. Cold Weather Placing: Comply with the requirements of ACI 306 and as follows:
1. Protect concrete work from physical damage and reduced strength that could be caused by frost, freezing actions, and low temperatures.
 2. When air temperatures has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F and not more than 80 degrees F at point placement.
 - a. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - b. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted for mix designs.
- I. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with the requirements of ACI 305 and as follows:
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete. Fogspray forms, reinforcing steel, and subgrade just before concrete is placed.
 3. When acceptable to Engineer, and when required by high temperatures, low humidity, or other adverse placing

3.7 FINISH OF FORMED SURFACES:

- A. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.
- B. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, painting or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed and fill all holes in a manner to create a smooth surface with no pockets

or pock marks. Engineer may require contractor to rub all exposed concrete surfaces to obtain acceptable smooth surface.

- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 SLAB FINISHES

A. Float Finish:

1. Apply float finish to slab surfaces to receive trowel finish, and other finishes specified.
2. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(f) 18 (floor flatness) and F(l) 14 (floor levelness) measured according to ASTM E 1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to uniform, smooth, granular texture.

B. Trowel Finish:

1. Apply where exposed-to-view, and where slab surfaces are to be covered with resilient flooring, carpet, ceramic tile, paint, or other thin film finish coating system.
2. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surfaces produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(f) 20 (floor flatness) and F(l) 17 (floor levelness) measured according to ASTM E 1155. Grind smooth surface defects, which would telegraph through applied, floor covering.

- C. Trowel and Fine Broom Finish: Where ceramic tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

- D. Non-Slip Broom Finish: At exterior walks and other locations indicated; specified in Division 2.

- E. Concrete Sealer: Apply in compliance with manufacturer's instruction's

- F. Concrete Stain and Color Sealer: Apply in compliance with manufacturer's instructions, including preparation of concrete slab; match approved sample.

3.9 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures; maintain concrete above 50 degrees F. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting; keep continuously moist for not less than 7 days. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.
- B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as specified.
1. Provide moisture curing by keeping concrete surface continuously wet by covering with water, by water-fog spray, or by covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
 2. Provide moisture-cover curing by covering concrete surface with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 3. Provide curing and sealing compound on interior slabs left exposed; and to exterior slabs, walks, and curbs, as follows:
 - a. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - b. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete. Contractor shall be solely responsible for this.
- C. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- D. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor toppings, and other flat surfaces by application of appropriate curing

compound. Final cure concrete surfaces to receive finish flooring by moisture-retaining cover, unless otherwise directed.

3.10 REMOVAL OF FORMS

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and until concrete has attained at least 75 degrees of design minimum compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

3.11 REUSE OF FORM

- A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated or otherwise damaged form material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten ferns to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces except as acceptable to Engineer.

3.12 MISCELLANEOUS ITEMS: Fill in holes and openings left in concrete for the passage of work by other trades after their work is in place. Mix, place, and cure concrete to blend with in-place construction. Provide all other miscellaneous.

3.13 CONCRETE SURFACE REPAIRS

- A. Repair and patch defective areas with cement mortar of the same type and class as the original concrete, immediately after removal of forms. Cut out honeycomb, rock pockets, voids over 1/2" diameter, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface, before placing cement mortar in the same manner as adjacent concrete. Proprietary patching compounds may be used when acceptable to Engineer.
 - 1. Smooth, Exposed-to-View Surfaces: Blend cements so that, when dry, patching mortar will match color of surrounding concrete. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
 - 2. Concerned Formed Surfaces: Repair defects that adversely affect the durability of the concrete. If defects cannot be repaired remove and replace the concrete.
 - 3. Engineer may use other repair methods, subject to acceptance.

3.14 FIELD SAMPLING AND TESTING

- A. An independent testing laboratory approved by Owner and Engineer will perform the following samples and tests. Refer to paragraph 1.4 C. for responsibility for payment of tests.
- B. Samples:
1. Field samples shall be made and cured in accordance with ASTM C 31, for each concrete strength, at the rate of 4 test cylinders and one slump test for each 50 cubic yards of concrete from each day's pour. In accordance with ASTM C 173 Volumetric Method, or ASTM C 231 Pressure Method, make air content check for each set of test cylinders. Air content and slump shall be checked and recorded at both truck discharge and point of placement for pumped concrete from the first load each day.
 2. Test cylinders as follows: one at 7 days, two at 26 days, and reserve the remaining for testing after a longer period as required by Architect, if the 28 day tests do not meet the required strength.
 3. The taking of samples from small pours of 10 cubic yards or less may be omitted at the discretion of the Engineer.
 4. Additionally, test slump every 25 cu. yds, recording location for report.
 5. When early form removal is requested, field cure cylinders tested at 7 or less days to determine sufficient strength.
- C. Testing:
1. Where average strength of any group of 3 cylinders falls below the minimum compressive strength or if individual cylinder falls more than 500 psi below minimum compressive strength specified, the Engineer shall have the right to require that test specimens be cut from the structure. Specimens shall be selected by Engineer from location in structure represented by test specimen or specimens which failed.
 2. Specimens shall be secured, prepared, and tested in accordance with ASTM C 42, within a period of 60 days after placing concrete.
 3. Concrete shall be considered to meet the strength requirement of this specification if it meets the strength requirements of paragraph 5.6.4 of ACI 318.
 4. Should laboratory analysis indicate that the proper concrete mix has not been used by the Contractor, all such concrete poured using the improper mix shall be subject to rejection.

5. The cost of cutting specimens from the structure, patching the resulting holes, and making the laboratory analysis shall be borne by the Contractor.
 6. The holes from which the cored samples are taken shall be packed solid with no slump concrete proportioned in accordance with the ACI 211 "Recommended Practice for Selecting Proportions of No-Slump Concrete." The patching concrete shall have the same design strength as the specified concrete.
 7. If any of the specimens cut from the structure fail to meet the requirements outlined in paragraph 5.6.4 of ACI 318, the Engineer shall have the right to require any and all defective concrete to be replaced, and all costs resulting there from shall be borne by the Contractor.
- D. Contractor Sampling: In addition to the slump tests specified above, the contractor shall keep a cone (mold) and rod apparatus on the job site for random testing of batches. When concrete does not meet the specified slump requirements, and when directed by the Engineer, immediately perform a slump test in accordance with ASTM C 143. Concrete not meeting the slump requirements shall be removed from the job site.

3.15 PROTECTION

- A. No wheeling, working, or walking on finished surfaces will be allowed for 16 hours after the concrete is placed or as otherwise dictated by weather conditions, concrete set, etc.
- B. Provide plywood or other acceptable protective cover at all traffic areas throughout the job.
- C. Protect exposed concrete floors, steps, and walks from paint and other materials or equipment, which may mar or damage these surfaces.

- 3.6 CLEAN-UP: Do not allow debris to accumulate. Clean up all concrete and cement materials, equipment and debris upon completion of any portion of the concrete work, and upon completion of entire cast-in-place concrete work.

END OF SECTION

SECTION 04 05 03

MASONRY MORTARING AND GROUTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes mortar and grout for masonry.

1.2 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 530 Building Code Requirements for Masonry Structures and ACI 530.1 Specification for Masonry Structures.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.
- B. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

PART 2 PRODUCTS

2.1 COMPONENTS

- A. Portland Cement: ASTM C150, Type I, gray color.
- B. Mortar Aggregate: ASTM C144, standard masonry type.
- C. Hydrated Lime: ASTM C206, Type S.
- D. Integral Water Repellant: Master Builder's "Rheomix 235" or approved equal.
- E. Grout Aggregate: ASTM C404, fine and coarse.
- F. Water: Clean and potable.
- G. Calcium chloride is not permitted.

2.2 MIXES

- A. Mortar Mixes:
 - 1. Mortar for Structural Masonry: ASTM C270, Type S consisting of 1 part volume Portland cement and ½ part hydrated lime to 4-1/2 parts aggregate.
 - 2. Mortar for Non-Structural Masonry: ASTM C270, Type N consisting of 1 part volume Portland cement and 1 part hydrated lime to 5 parts aggregate.

- B. Mortar Mixing:
 - 1. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.

- C. Grout Mixes:
 - 1. Bond Beams and Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; mixed in accordance with ASTM C476 Course grout.

- D. Grout Mixing:
 - 1. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476.
 - 2. Do not use anti-freeze compounds to lower freezing point of grout.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install mortar and grout in accordance with Sections 04 20 00 and 04 72 00.

END OF SECTION

SECTION 04 20 00

UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Brick and concrete masonry units.
 - 2. Reinforcement, anchorage, and accessories.

1.2 SUBMITTALS

- A. Product Data: Submit product data for reinforcement, wall ties, cell vents, and other accessories.
- B. Samples: Submit four samples of face brick units to illustrate color, texture and extremes of color.
- C. Manufacturer's Certificate: Submit certificate for block requirements.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with TMS MSJC Code and TMS MSJC specification, unless noted otherwise.
- B. Reinforced CMU Construction: Conform to the provisions of ANSI A41.2 (NBS Handbook 74) and ACI 530 / ACI 530.1.

1.4 MOCKUP

- A. Construct masonry wall mockup including masonry, stone, mortar and accessories, flashings, and weather barrier.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.
- B. Cement: Furnish in original packages. Discard any damaged or deteriorated material.
- C. Aggregate: Store to prevent inclusion of dirt and other foreign matter.
- D. Brick: Store in bundles and on delivery pallets or on platforms off the ground.
- E. Concrete Masonry Units: Deliver to jobsite dry. Store on platforms until ready for use. Keep dry at all times. Wet or damp blocks are unacceptable and shall be removed from the site and replaced at no extra cost or delay.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.
- B. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

PART 2 PRODUCTS

2.1 BRICK

- A. Brick: ACME Blend 137 Burgundy Heritage
- B. Brick Size and Shape:
 - 1. Regular Brick: Nominal size of 3-5/8 x 2-1/4 x 7-5/8 inches.
 - 2. Triple Brick: Nominal size of 7-5/8 x 2-1/4 x 7-5/8 inches.
- C. Special Brick Shape: Furnish special brick shapes at window sills.

2.2 CONCRETE MASONRY UNITS

- A. Hollow Load Bearing Concrete Masonry Units: ASTM C90, Moisture controlled; light weight.

2.3 ACCESSORIES

- A. Single Wythe Joint Reinforcement: ASTM A951; ladder type; high tensile strength steel; No. 9 steel rods with eye and wire pintels; hot dip galvanized.
- B. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade, deformed billet bars, galvanized finish.
- C. Strap Anchors: Bent steel shape; ASTM A153/A153M hot dip galvanized.
- D. Wall Ties: ASTM A82; Hohmann & Barnard, X-Seal Anchor with X-Seal Tape, and S.I.S. Anchor and Byna-Lok, hot dip galvanized, or approved equal.
- E. Anchor Rods: ASTM A307; Grade C; J-shaped or L-shaped; complete with washers and heavy hex nuts; sized for minimum 15 inch embedment; galvanized finish.
- F. Mortar and Grout: As specified in Section 04 05 03.
- G. Reinforced Flashings: Hyload Flashing System; polymeric membrane reinforced with DuPont's Elvaloy KEE polymer, 40 mil thick. Provide preformed corners, end dams, other special shapes, and seaming materials by same manufacturer.
- H. Pre-coated Galvanized Steel: Refer to Section 07 62 00.
- I. Preformed Control Joints:
 - 1. Brick: Closed cell neoprene material, 3" wide x maximum length.

2. Concrete Masonry: Polyvinyl chloride material. Provide with corner and tee accessories, such as #VS-1118 as manufactured by Hohmann & Barnard. Inc.
- J. Cavity Drain Material: Open polyethylene mesh thickness required to fill cavity space, and shaped to ensure moisture drainage to cavity weeps.
- K. Building Paper: ASTM D226; Type II, No. 30 unperforated asphalt felt.
- L. Weeps/Vents: Hohmann & Barnard Series 341; round plastic weep holes.
- M. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 EXECUTION

3.1 PREPARATION

- A. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.

3.2 INSTALLATION

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.
- C. Coursing of Brick Units:
 1. Bond: Running.
 2. Coursing: Three units and three mortar joints to equal 8 inches.
 3. Mortar Joints: Concave.
- D. Coursing of Concrete Masonry Units:
 1. Bond: Running.
 2. Coursing: One unit and one mortar joint to equal 8 inches.
 3. Mortar Joints: Tooled slightly concave.
- E. Joint Reinforcement and Anchorage - Masonry Veneer:
 1. Install horizontal joint reinforcement 16 inches oc.
 2. Place masonry joint reinforcement in horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
 3. Place joint reinforcement continuous in joint below top of walls.
 4. Lap joint reinforcement ends minimum 6 inches.
 5. Secure wall ties to stud framed backing and embed into masonry veneer at maximum 16 inches oc vertically and horizontally.
 6. Place wall ties at maximum 8 inches oc vertically within 8 inches of jamb of wall openings.
 7. Place wall ties at maximum 8 inches on center horizontally within 8 inches of head and sill of wall openings.
- F. Joint Reinforcement and Anchorages - Cavity Wall Masonry:
 1. Install horizontal joint reinforcement 16 inches oc.

2. Place masonry joint reinforcement in horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
 3. Place joint reinforcement continuous in joint below top of walls.
 4. Lap joint reinforcement ends minimum 6 inches.
- G. Placing and Bonding:
1. Lay solid masonry units in full bed of mortar, with full head joints.
 2. Lay hollow masonry units with face shell bedding on head and bed joints.
 3. Remove excess mortar as work progresses.
 4. Interlock intersections and external corners.
 5. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
 6. Perform job site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
 7. Isolate masonry from vertical structural framing members with movement joint.
 8. Isolate top of masonry from horizontal structural framing members and slabs or decks with compressible joint filler.
- H. Weeps and Vents:
1. Furnish weeps and vents in outer wythe at maximum 16 inches oc above thru-wall flashing, above shelf angles and lintels, and at bottom of walls.
 2. Install weeps and vents at brick units at 16" o.c. with additional vents as shown on Drawings.
- I. Cavity Wall: Do not permit mortar to drop or accumulate into air space or to plug weeps.
- J. Masonry Flashings:
1. Extend flashings horizontally through outer wythe at foundation walls, above ledge or shelf angles and lintels, at bottom of walls, and turn down on outside face to form drip.
 2. Turn flashing up minimum 8 inches and bed into mortar joint of backing.
 3. Lap end joints minimum 6 inches and seal watertight.
 4. Turn flashing, fold, and seal at corners, bends, and interruptions.
- K. Lintels:
1. Install lintels over openings.
 2. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled or indicated.
 3. Allow masonry lintels to attain specified strength before removing temporary supports.
 4. Maintain minimum 8 inch bearing on each side of opening.
- L. Grouted Components:
1. Place and consolidate grout fill without displacing reinforcing.
 2. Place grout in accordance with TMS MSJC Specification.
- M. Control and Expansion Joints:
1. Install control and expansion joints at 20 feet on center and within 24 inches on one side of each interior and exterior corner.
 2. Install preformed control joint device in continuous lengths. Seal butt and corner joints.

3. Size control joint in accordance with Section 07 90 00 for sealant performance.

3.3 CLEANING

- A. Remove excess mortar and mortar smears as work progresses.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- 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 for Steel Reinforcement:
 1. Plus or minus 1/2 inch when distance from centerline of steel to opposite face of masonry is 8 inches or less.
 2. Plus or minus 1 inch when distance is between 8 and 24 inches.
 3. Plus or minus 1-1/4 inch when distance is greater than 24 inches.
 4. Plus or minus 2 inches from location along length of wall exceeding 24" length.
 5. Plus or minus 1 inch from location along length of wall not exceeding 24" length.

3.5 CLEANING

- A. Remove excess mortar and mortar smears as work progresses.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with non-acidic cleaning solution.
- D. Use non-metallic tools in cleaning operations.

3.6 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution Requirements: Requirements for protecting finished Work.
- B. Protect exposed external corners subject to damage.
- C. Protect base of walls from mud and mortar splatter.
- D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.
- E. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

END OF SECTION

SECTION 04 72 00
CAST STONE MASONRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cast stone units.
 - 2. Anchors and supports.
 - 3. Accessories.

1.2 DESIGN REQUIREMENTS

- A. Wind Loads: Design anchors to withstand positive and negative wind loads acting normal to plane of wall, including increased loads at building corners.

1.3 SUBMITTALS

- A. Shop Drawings: Required.
- B. Product Data: Required.
- C. Samples: Required.

1.4 MOCKUP

- A. Provide full sized units to be incorporated into mockup wall specified in Section 04 20 00.

1.5 WARRANTY

- A. Provide manufacturer's limited lifetime warranty.

PART 2 PRODUCTS

2.1 CAST STONE

- A. Manufacturers:
 - 1. Continental Cast Stone Manufacturing Co.
 - 2. Rockcast
 - 3. Substitutions: Permitted.
- B. Product Description: ASTM C1364, architectural cast stone units, with fine grained texture, simulating natural cut stone.
- C. Color and Finish: As selected.

2.2 COMPONENTS

- A. Portland Cement: ASTM C150; white color.
- B. Coarse Aggregates: ASTM C33, except grading requirements; granite, quartz or limestone.
- C. Fine Aggregates: ASTM C33, except grading requirements; manufactured or natural sand.
- D. Colors: ASTM C979; inorganic iron oxide pigments.
- E. Admixtures: ASTM C494/C494M.
- F. Fly Ash: ASTM C618.
- G. Water: Potable.

2.3 ACCESSORIES

- A. Mortar: As specified in Section 04 05 03.
- B. Flashings: As specified in Section 04 20 00.
- C. Sealant: Type specified in Section 07 90 00; color as selected to match cast stone color.
- D. Weeps: As specified in Section 04 20 00.
- E. Cleaning Solution: Non-acidic, not harmful to cast stone work or adjacent materials.
- F. Miscellaneous: Provide connection materials including steel plates, shapes, bolts, washers, and angles cast into units. Hot dip galvanize all plates, inserts, bolts, and other accessories

2.4 FABRICATION

- A. Size: As indicated on Drawings.
- B. Form units to length required for joint layout indicated on shop drawings. Field cutting to length is not permitted.
- C. Reinforce units in accordance with ASTM C1364.
- D. Form external corners to quirk joint profile.
- E. Form drip slot in bottom surface full width of projection.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Maintain cast stone courses to uniform dimension. Form bed and head joints of uniform thickness.

- B. Pull units from multiple cubes during installation to minimize variation in color and help with natural blending.
- C. Cast Stone Coursing:
 - 1. Joint Location: As indicated on Drawings.
 - 2. Joint Width: 3/8 inches.
 - 3. Joint Shape: Concave.
- D. Placing and Bonding:
 - 1. Lay cast stone units in full bed of mortar, with full head joints.
 - 2. Fill dowel holes and anchor slots with mortar.
 - 3. Rake mortar joints 3/4 inches deep for pointing.
 - 4. Tuck point mortar joints. Tool joint surface to shape specified.
 - 5. Cut units using motor-driven masonry saws. Turn finished ends to the visible side and the saw cut turned to the inside of the mortar joint to hide exposed aggregates and saw marks.
- E. Flashings:
 - 1. Extend flashings horizontally through cast stone veneer at foundation walls, above ledge or shelf angles and lintels, under parapet caps, and at bottom of walls, and turn down on outside face to form drip.
- F. Control Joints:
 - 1. Form control joint by omitting mortar and sealing joint in accordance with Section 07 90 00.

3.2 TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8" in 5' or 1/4" in 20' or more.
- B. Variation from Level: Do not exceed 1/8" in 5', 1/4" in 20', or 3/8" maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8" or 1/4" or normal joint width, whichever is greater.
- D. Variation in Plane between Adjacent Surfaces: Do not exceed 1/8" difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

END OF SECTION

SECTION 053100 ROOF DECK

PART ONE - GENERAL

1.1 SECTION INCLUDES

- 1.1.1 Applicable requirements of Condition of Contract and General Requirements apply to Work specified in this Section.
- 1.1.2 Work included:
 - a. Provide steel roof deck.
- 1.1.3 Related work specified elsewhere:
 - a. Metal Fabrication and Miscellaneous Metal Work: Section 055000

1.2 QUALITY ASSURANCE

- 1.2.1 Metal deck shall be designed in accordance with the latest edition of the Steel Deck Institute's (SDI) - "Specifications and Commentary for Steel Roof Deck."
- 1.2.2 The roof deck shall be designed, manufactured and installed to meet Factory Mutual Class I construction.

1.3 REFERENCE STANDARDS

- 1.3.1 AISI - "Specification for the Design of Cold-Formed Steel Structural Members."
- 1.3.2 ASTM A572 - Structural Steel.
- 1.3.3 ASTM A924-94 - Steel Sheet, Zinc-Coated, Galvanized coating process by the Hot-Dip Process.
- 1.3.4 ASTM 653-94 steel, cold-formed sheet, carbon, structural quality.
- 1.3.5 ASTM A611 - Steel, Cold-Rolled Sheet, Carbon, Structural.
- 1.3.6 AWS D1.1 - Structural Welding Code.
- 1.3.7 AWS D1.3 - Specification for Welding Sheet Steel in Structures.
- 1.3.8 SDI - "Design Manual for Composite Decks, Form Decks and Roof Decks."
- 1.3.9 AISC - Manual of Steel Construction.
- 1.3.10 SDI - Diaphragm Design Manual.

1.4 SUBMITTALS

1.4.1 Submit 5 sets of Shop Drawings for review of general conformance to design concept in accordance with Section 013000. Erection Drawings shall show type of deck, shop finish, accessories, method of attaching, edge details, deck openings and reinforcement, and sequence of installation.

1.5 STORAGE

1.5.1 Store materials off ground with one end elevated on wood sleepers to provide drainage. Protect deck from elements with a waterproof covering and ventilate to avoid condensation.

PART TWO - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Vulcraft A Division of Nucor Corporation.
United Steel Deck, Inc. Summit, N.J. or Approved Equal.

2.2 MATERIALS

2.2.1 Sheet steel shall conform to ASTM A611 Grade C, D or E (for prime painted decks) and ASTM A653-94, structural quality (for galvanized decks) and have a minimum yield strength of 33,000 PSI.

2.2.2 Bearing Plates and/or Angles shall be ASTM A572 steel.

2.2.3 Welding Methods and Materials shall conform to AWS D1.1 and AWS D1.3.

2.2.4 Steel Closure Strips, Ridge and Valley Plates, and Related Accessories shall be a minimum of 22 gage sheet steel of required profiles and sizes.

2.2.5 Finish:

Galvanizing shall conform to the requirements of ASTM A924-94 coating Class G60.
Shop Primer shall be acrylic medium gray.

Touch-up primer shall be compatible with manufacturer's primer.

2.2.6 Mechanical fasteners shall be Teks as manufactured by Builds, St. Charles Road, Elgin, Illinois, 60120. Selection of Teks fasteners not specified herein shall be in accordance with the manufacturer's recommendations.

2.3 FABRICATION

2.3.1 Steel deck shall have formed ribs of the type, finish, dimension and gage as shown on Drawings.

2.3.2 Fabricate deck in lengths to have three continuous spans or more whenever possible. Fabricate sheets to lap a minimum of 2" over supports at ends. Lap joints required where roof pitch changes due to the deck support elevations.

2.3.3 Design steel decking in accordance with SDI "Design Manual for Composite Decks, Form Decks, and Roof Decks." The maximum working stress shall not exceed 20,000 PSI. The maximum working stress shall in no case exceed the maximum yield strength of the steel

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divided by 1.65 but may be increased by 33% for temporary concentrated loads provided the deck thus required is not less than that required for the specific uniform load. The deflection of the Deck under design live load shall not exceed 1/240 of the span. Minimum thickness of material supplied shall be within 5% of the design thickness.

- 2.3.4 Section properties used in determining stress and deflection shall be calculated in accordance with the latest edition of the Steel Deck Institute's "Design Manual for Floor Decks and Roof Decks."
- 2.3.5 Provide fabricate roof sump pan of 14 gage sheet steel, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, watertight. Typical at all roofdrains.
- 2.3.6 Provide 6" closure strip where changes in deck direction occur. Closure shall be same gauge as deck.

PART THREE - EXECUTION

3.1 INSTALLATION

- 3.1.1 On steel support members provide 1-1/2" minimum bearing. Align and level on supports.
- 3.1.2 Fasten steel deck units to structural supports using Hex washer head Tekes per drawing requirements or arc spot welds providing equivalent horizontal shear capacity as developed by screw pattern shown on drawings according to manufacturers' specifications and direction layouts and as specified herein. Decks thinner than .0280 inches shall be welded using 16 ga. welding washers with a 3/8" diameter hole. Side lap connections shall be screwed in accordance with requirements shown on drawings.
- 3.1.3 Attach ridge and valley plates and steel cant strips directly to the steel deck where shown on the Drawings to provide a finished surface for the application of insulation and roofing.
- 3.1.4 Cutting of openings through the deck less than 16 square feet in area, and all skew cutting shall be performed in the field.
- 3.1.5 Arc spot welds (puddle welds) to supports if used shall have a diameter of 5/8" minimum, or an elongated weld of 3/8" minimum width and 3/4" minimum length. Weld metal shall penetrate all layers of deck material at end laps and have adequate fusion to the supporting members. Welding shall be done in accordance with the American Welding Society Standard "Specification for Welding Sheet Steel in Structures", AWS D1.3.
- 3.1.6 Minimum fastening of deck to supports and side laps.
 - a. Deck ends at building perimeter: 6" o/c
 - b. Deck end laps: 6" o/c (min.)
 - c. Deck sides at building perimeter and deck side laps: Deck units with spans greater than five feet shall be fastened at midspan or at 36" intervals whichever is smaller.
 - d. See drawings for requirements beyond these minimum requirements.

- 3.1.7 At ends of decks or where changes of deck direction occur, fasten at each flute. Furnish and install adequate closures and fasten to both sides at 18" o.c.
- 3.1.8 Accessories shall be fastened to supports or deck with mechanical fasteners at not over 6" o.c. and at all corners and ends.
- 3.1.9 Position roof sump pans with flange bearing on top surface of deck. Screw at each deck flute.
- 3.2 CLEAN UP AND FINAL ADJUSTMENTS
 - 3.2.1 Touch up surface coating damage and abrasions using a paint compatible with primer paint and/or specially formulated for use with galvanized steel.
 - 3.2.2 Installation holes shall be sealed with a closure plate 2 gauges thicker than deck and mechanically fastened to deck. Steel deck with holes visible from below will be rejected. Deck units that are bent, warped, or damaged in any way which would impair the strength and appearance of the deck shall be removed from site.
 - 3.2.3 Steel decking work and accessories, when complete, shall be solid, smooth, and uniform in appearance.
 - 3.2.4 Remove any unused steel deck, edge trimmings, screws, weld washers, butt ends of welding electrodes and other debris from completed installation.

END OF SECTION

SECTION 054000

LIGHTGAGE METAL FRAMING

PART 1 - GENERAL

1.1 SCOPE

All light gage steel studs, tracks, bridging and related accessories are as indicated on the Contract Drawings and specified herein.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Structural Steel: Section 055000
- B. Gypsum Wallboard: Section 092500

1.3 QUALITY ASSURANCE

- A. Qualifications of manufacturer: products used in the work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable by the Engineer.
- B. Inspection and Quality Control:
 - 1. Contractor shall provide effective full time quality control over all fabrication and erection activities.
 - 2. As directed by Engineer, owners testing agency may inspect the maintenance of a quality control program including spot checking weldments and welding procedures in accordance with A.W.S. standards.
 - 3. Inspection responsibility for quality control shall remain with contractor.
- C. Standards:
 - 1. Work shall meet the requirements of the following standards:
 - a. American Iron and Steel Institute (A.I.S.I.) "Design of Cold Formed Steel Structural Members", 1986 with 1989 amendments.
 - b. "American Welding Society" (A.W.S.) D.1.3, 1981 "Structural Welding Code-Sheet Steel".
 - c. "American Society for Testing and Materials", (A.S.T.M.)
 - d. "American Institute of Steel Construction (A.I.S.C.) Manual of Steel Construction," 9th edition.
 - e. All pertinent Federal, State and Local Codes.
 - 2. The most stringent requirements shall govern in conflicts between specified codes and standards.

1.4 SUBMITTALS

- A. General: Comply with Section 013000

- B. Product Data: Submit copy of installation instructions for each item of lightgauge framing and accessories.
- C. Shop Drawings: Submit four full size prints of Contractor's stamped and approved shop drawings for Engineer's review. Do not submit copies of design drawings marked up for shop drawings. Only independently developed shop drawings will be considered. Do not submit electronic copies of shop drawings. Electronic submittals will be rejected. Fabrication and erection drawings for framing members shall show size and gage designations, number, type, location and spacing. Indicate supplemental bracing, accessories, and details as may be required for proper installation.

1.5 PRODUCT DELIVERY AND STORAGE

- A. Protect metal framing units from rusting and damage. Deliver to the project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type, location and spacing. Indicate supplemental bracing, accessories, and details as may be required for proper installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Dietrich, Marino, Superior, Gold Bond, Delta, or approved equal.

2.2 METAL FRAMING

- A. Systems Components: With each type of metal framing required, provide manufacturer's standard steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories as indicated and as recommended by manufacturer for applications indicated, as needed to provide a complete metal framing system.
- B. Material and Finishes
 - 1. All galvanized studs shall be formed from steel that corresponds to the minimum requirements of 1986 A.I.S.I. standards with 1989 amendments.
 - 2. All galvanized studs, track, bridging and accessories shall be formed from steel having a galvanized coating meeting the requirements of ASTM A653.
 - 3. "CSJ"-Shape Studs: Minimum 18 gage, with 1.625" flange and 0.50" flange return lip. 18 gage units shall have yield stress (Fy)= 33ksi and 16,14,12,10 gage units shall have a yield stress (Fy)=50 ksi.
 - 4. Track size to match gage of studs.
- C. Fasteners (unless shown on plans otherwise):
 - 1. Connection of track to steel, No. 12-14 screws at 18-inches on center. Connection of track to concrete, 0.145" dia. shank x 1 1/8 Power Driven Fasteners at 12-inches on center.
 - 2. Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.
- D. Electrodes for welding: Comply with AWS Code and as recommended by stud

manufacturer.

- E. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.

2.3 FABRICATION

A. General

1. Framing components may be prefabricated into panels prior to erection. Fabricate panels plumb, square, true to line and braced against racking with joints welded. Perform lifting of prefabricated panels in a manner to prevent damage or distortion in any members in the assembly.
2. Fabricate units in jig templates to hold members in proper alignment and position and to assure consistent component placement.
3. Splices in studs shall not be permitted.

B. Fastenings.

1. Fastening of components shall be with self-drilling screws or welding. Screws shall be of sufficient size to insure the strength of the connection. Wire tying of components shall not be permitted. All welds shall be touched up with a zinc-rich paint.
2. Wire taping of framing components is not permitted.
3. Welds shall be performed by operators qualified in accordance with Section 6.0 of the American Welding Society's A Structural Welding Code-Sheet Metal @ (AWS D1.3-81). (Where field welds are anticipated, we suggest that components of 20 gage thickness are not specified). All welds shall be touched up with zinc rich paint.

C. Fabrication Tolerances:

1. Fabricate units to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8" in 10'.
2. Studs shall have full bearing inside track web (1/16" max. gap), prior to stud and track attachment.

PART 3 - EXECUTION

- 3.1 INSTALLATION: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations, and final shop drawings.

- A. Runner tracks: Install continuous tracks sized to match studs. Align tracks accurately to the layout at base and top of studs. Secure tracks as recommended by the stud manufacturer for the type of construction involved, except do not exceed 16" o.c. spacing for nail or power-driven fasteners, not 12" o.c. for the other types of attachment. Provide fasteners at corners and ends of tracks.

B. WALL STUDS: Space studs 16" o.c.

1. Secure studs to top and bottom runner tracks by either welding or screw

fastening at both inside and outside flanges.

2. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
3. Where stud system abuts structural columns or walls anchor ends or stiffeners to supporting structure.
4. Install supplementary framing, blocking and bracing in the metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with the stud manufacturer's recommendations and industry standards in each case, considering the weight or loading resulting from the items supported.
5. Frame wall openings larger than 2' square with double stud at each jamb of frame except where more than two are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure studs system wall opening frame in manner indicated.
6. Frame both sides of expansion and control joints, as shown for the wall system, with a separate stud; do not bridge the joint with components of the stud system.
7. Install horizontal bridging in stud system, spaced (vertical distance) at not more than 4 ft o.c. Weld at each intersection.
8. Temporary bracing shall be provided until erection is completed.
9. Provide stud walls at locations indicated on plans as shear walls @ for frame stability and lateral load resistance.

C. Erection Tolerances:

1. Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true-to-line joints.
2. Maximum variation in plane and true position between prefabricated assemblies should not exceed 1/16".

- 3.2 FIELD PAINTING: Touch-up shop-applied protective coating damaged during handling and installation. Use galvanizing repair paint for galvanized surfaces.

END OF SECTION

SECTION 055000
METAL FABRICATIONS AND MISCELLANEOUS METAL WORK

PART 1 - GENERAL

- 1.1 GENERAL CONDITIONS: All work under this section is subject to the General Conditions and Supplementary General Conditions and shall be governed by the requirements therein.
- 1.2 SCOPE: This section shall include the furnishing and erection of all structural steel. No structural steel members shall be cut or altered by any of the trades, without written permission from the Engineer.
- A. Steel supports for work of other trades.
 - B. Furnish miscellaneous metal steel attachments, anchors, plates, angles, etc.
 - C. Include all anchors, angles, bolts, expansion shields for items in this section only, and other accessories shown in details and or required for the complete installation of all work.
- 1.3 VERIFY DIMENSIONS: General Contractor shall field verify existing dimensions prior to fabrication of structural steel.
- 1.4 SHOP DRAWINGS: Steel fabricator shall submit 5 copies of detailed and checked shop drawings for approval by the Engineer. All drawings shall clearly show location and sizes of all material, all building dimensions and elevations pertinent to the structure, and any other miscellaneous technical and erection data required for approval and construction. These shop drawings must be approved by the engineer before fabrication and shipment. PARTIAL SUBMITTALS WILL NOT BE ACCEPTED UNLESS APPROVED IN ADVANCE WITH THE ENGINEER. Design drawings shall not be used for fabrication or erection drawings.

PART 2 - MATERIALS

- 2.1 STRUCTURAL STEEL SHALL CONFROM TO THE FOLLOWING:
- A. W-shaped members shall be full length members without any splices conforming to requirements of ASTM A-992.
 - B. Flat Plates, Bent Plates, angles, round bars, and channels: Specifications for Structural Steel, ASTM A36.
 - B. Steel pipe: Specifications for Cold-Formed Welded Seamless Carbon Steel Structural Tubing in Rounds and Shapes ASTM A500 and Specification for Hot-Formed Welded Seamless Carbon Steel Structural Tubing, ASTM A501 (Fy = 36ksi).
 - C. Steel tubing: Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes ASTM A500 Fy = 46 ksi.
- 2.2 FASTENERS SHALL CONFORM TO THE FOLLOWING:

- A. Arc-welding electrodes: American Welding Society "Specifications for Iron and Steel Arc-Welding Electrodes", latest addition, Type E70XX
 - B. Bolts
 - 1. Bolts for column anchor bolts: Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners, ASTM A307 unless otherwise indicated on plans.
 - 2. Bolts for main structural connections or bolts not otherwise specified: Specification for High Strength Bolts for Structural Steel Joints Including Suitable Nuts and Plain Hardened Washers, ASTM A325 Type N and ASTM A490. Include suitable nuts and plain hardened washers.
 - C. Expansion Anchors in Concrete: Federal Specification FF-S-325 Amendment #3, Group II, Type 4, Class 1 Anchor.
- 2.3 CONNECTOR SHALL CONFORM TO THE FOLLOWING:
- A. Headed and Threaded Studs: Shall conform to ASTM 108
Fy =60ksi minimum tensile strength and Fy=50ksi minimum yield strength. Studs shall be solid fluxed attached with appropriate stud gun capable of meeting the strengths set forth in Table 1.11.4 AISC Specification.
- 2.4 MECHANICAL EQUIPMENT FRAMES: All mechanical equipment frames or miscellaneous steel required to complete the mechanical equipment installation shall be provided and detailed by the structural steel fabricator. The mechanical equipment contractor shall provide all necessary weights and dimensions to the structural steel fabricator. Shop drawings for mechanical and equipment frames must be submitted and accepted by the Architect.
- 2.5 FABRICATION
- A. Workmanship and fabrication shall be in accordance with AISC "Specification, Design, Fabrication and Erection of Structural Steel for Buildings" and with the following outline.
 - B. Welding shall be in accordance with the "Standard Code for Arc Welding in Building Construction" of the American Welding Society.
 - C. All miscellaneous steel shall be kept free of mud and dirt. Any dirty or muddy steel shall be washed clean.
 - D. Bearing surfaces shall be planned to true beds. Abutting surfaces shall be closely fitted.
 - E. All columns and bearing stiffeners shall be milled to give full bearing over the cross section. Column base plates 2" or less in thickness may be used without planning. It will not be necessary to plane bottom surfaces of plates or grout beds.
 - F. There shall be no splices (shop or field, bolted or welded) along steel members other than at locations shown on plans.

- G. Bolted connections shall meet AISC Specification for Structural Joints using ASTM A325 Type N and ASTM A490.

2.6 PAINTING

- A. Deliver paint to shop and job in original sealed containers clearly marked with the manufacturer's name and identifying brand number or name. Use paint as prepared by the manufacturer without thinning or other admixture.
- B. All miscellaneous steel shall be shop painted as follows:
 - 1. Shop prepare steel to receive primer per requirements of paint supplier.
 - 2. Apply one coat of Sherwin Williams B50 Kem Kromik Universal Metal Primer @ 3 mils DFT/CT or approved equal to all surfaces of steel work.
 - 3. Shop paint all primed steel with 2 coats of Sherwin Williams Acrolon 218 HS acrylic polyurethane @ 3 mils DFT/CT or approved equal with color and finish as selected by owner.
 - 4. Do not apply shop paint within 2" of surfaces to be field welded.
 - 5. Do not apply shop paint to steel to be fire-proofed.

PART 3 - EXECUTION

3.1 ERECTION

- A. Erection shall include the setting of all columns and bases and erection of all structural steel as called for under the contract for furnishing and delivery of structural steel, but shall not include the setting of loose lintels (to be set by mason).
- B. Set column bases and beam plates 12" x 12" and larger to accurate elevations approximately 1" clear of masonry on steel wedges and/or bolts as indicated on drawings. These will be grouted by the mason who will also set small beam plates. Wooden wedges shall not be used. Set anchor bolts to be concreted in by the mason.
- C. See the drawings and general notes for field connections.
- D. Field errors shall not be corrected by burning except with the permission of the Architect.
- E. Brace and guy all structural members until all connections are made.
- F. After erection, touch up all injuries to priming coat and all others where field welding is done. Bolt heads and nuts shall be touched up in field. Use same material as specified for shop coat.

- G. Assembled parts shall be brought into close contact and drift pins shall be used only for bringing members into position, not to enlarge or distort holes.

3.2 WELDING

- A. Welding in shop and field shall be done by operators who have been previously qualified by tests as prescribed in the American Welding Society, "Standard Qualification Procedure." All operators must have successfully passed the welding qualification tests within a 24-month period preceding erection. The Architect shall be provided a copy of the welding qualification test for each operator at no additional cost to the Owner.
- B. Equipment to be of a type which will produce proper current so that operator may produce satisfactory welds. Welding machine shall be of 200-400 ampere, 25-40 volt capacity.
- C. Electrodes shall be suitable for positions and other conditions of intended use in accordance with the instructions with each container.
- D. Field welding shall be done by direct current.
- E. Technique of welding employed, the appearance and quality of welds made and methods of correcting defective work shall conform to American Welding Society "Code for Arc Welding in Building Construction", Section 4, "Workmanship".
- F. Surfaces to be welded shall be free from loose scale, rust grease, paint and other foreign material except that mill scale withstanding vigorous wire brushing may remain. A light film of linseed oil may likewise be disregarded. Joint surfaces shall be free from fins and tears.
- G. No welding shall be performed when temperature of the base metal is lower than 0 degrees F. At temperatures between 32 degrees F and 0 degrees F., the surfaces of all areas within 3" of a point where a weld is started shall be heated until they are too hot to touch before welding is started.
- H. Finished members shall be true to line and free from twists, bends and open joints.

3.3 TESTS

- A. Laboratory tests. Methods of testing shall be according to the following:
 - 1. STRUCTURAL STEEL - ASTM A-36 or ASTM A572. Two tension tests from each melt. Two bend tests from each melt.
 - 2. STEEL ELECTRODES - ASTM A-233. As directed.
- B. Field Tests. All field and shop welders shall be tested and certified by an approved testing laboratory. The American Welding Society Operator Qualification test shall be used as a basis of qualification.
 - 1. All field and shop operators shall qualify for the following:

Type of Weld	Position of Welding
--------------	---------------------

Groove	Horizontal
Groove	Vertical
Groove	Overhead
Fillet	Vertical
Fillet	Overhead

- C. The Engineer's Representative may require strap cuts from welds in any supporting member to withstand nick-break test. If strap fails to meet requirements, Contractor shall replace strap cut from member at no charge to Owner. If strap does meet requirements, the Engineer shall pay expenses of having metal replaced. In event strap fails, the welder shall be discharged.
- 3.4 ENGINEER OBSERVATION: The work shall be observed in the shop and the field. The Contractor shall give proper notice and allow full facilities for this observation. Notify Engineer 48 hours prior to shipping structural steel.
- 3.5 SPECIAL INSPECTIONS The contractor shall hire an independent inspection firm to perform the special Inspections listed on sheet s1.1 of the design drawings.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preservative treatment of wood.
 - 2. Concealed wood blocking for support of toilet and bath accessories and other wall hung items.

1.2 QUALITY ASSURANCE

- A. Grading Marks: Factory-mark each piece of lumber and plywood with type, grade, mill and grading agency identification; and submit mill certificate that material has been inspected and graded in accordance with requirements if it cannot be marked on a concealed surface.
- B. Wood Preservative Treatment: Label each piece of pressure treated lumber with the Quality Control mark of the American Wood Preservers Bureau showing compliance with the appropriate standard.
- C. Perform Work in accordance with the following:
 - 1. Lumber Grading Agency: Certified by SPIB (Southern Pine Inspection Bureau).
 - 2. Lumber: DOC PS 20.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Keep carpentry materials dry during delivery, storage and handling. Store lumber in stacks for air circulation within stacks. Protect bottom of stacks against contact with damp surface. Protect exposed materials against weather. Do not store dressed or treated lumber or plywood outdoors.

PART 2 PRODUCTS

2.1 LUMBER MATERIALS

- A. Lumber Grading Rules: SPIB, KD, S4S, Southern Pine No. 2.
- B. Provide single bottom plate and double-top plates 2" thick by width of studs, except where otherwise indicated.

2.2 ACCESSORIES

- A. Fasteners and Anchors: Z-Mac coating on galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.

- B. Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete. Bolt or ballistic fastener for anchorages to steel.

2.3 FACTORY WOOD TREATMENT

- A. Pressure treat above-ground items with water-borne preservatives comply with AWPA C2 lumber and AWPA C9 plywood. After treatment, kiln-dry to maximum moisture content, of 19 percent. Treat indicated items and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry and concrete.
 - 3. Wood framing members less than 18" above grade.
 - 4. Wood floor plates installed over concrete slabs directly in contact with earth.
- B. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces with heavy brush coat of same chemical used for treatment and to comply with AWPA M4.
- C. Wood Preservative (Pressure Treatment): AWPA Treatment C1 using water borne preservative with 0.25 percent retainage.
- D. Moisture Content after Treatment: Kiln dried (KDAT).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.
- B. Set carpentry work to required levels and lines, with members plumb and true to line and cut and fitted.
- C. Securely attach carpentry work to substrate by anchoring and fastening as indicated and as required by recognized standards. Countersink nail heads on exposed carpentry work and fill holes.
- D. Use common wire nails, except as otherwise indicated or specified. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.
- E. Anchor carpentry work to anchorage devices or blocking built-in or directly attached to substrates. Secure to grounds, strips, backing, and blocking, of thickness and shape required to secure work and equipment in place, as indicated on the drawings or required by conditions. Fasten wood grounds, furring and other engaging woodwork to various types of walls with approved types and sizes of nails, ties, and inserts, spaced to provide rigid secure supports.

- F. Set structural members level and plumb, in correct position.
- G. Fasten framing in accordance with applicable code.
- G. Provide wood grounds, strips, bucks, plates, backing, and blocking, of thickness and shape required to secure work and equipment in place, as indicated on drawings or required by conditions. Fasten with approve types and sizes of nails, ties, and inserts, spaced to provide rigid secure supports.
- H. Provide rough hardware necessary or required for installation of work specified. Use sufficient size and number of spikes, nails, screws, bolts, etc., to ensure rigidity, security, and permanence.

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Finish carpentry items.
 - 2. Hardware and attachment accessories.

1.2 SUBMITTALS

- A. Shop Drawings: Required.
- B. Product Data: Required for all hardware.
- C. Samples: Required to show match to prefinished wood doors.

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with AWI Quality Standards, Custom Grade.
- B. Surface Burning Characteristics: Maximum 24/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

PART 2 PRODUCTS

2.1 COMPONENTS – WOOD VENEERED MILLWORK

- A. Exposed and Semi-Exposed Surfaces: AWI Grade Custom.
 - 1. Species of Wood: Walnut.
 - 2. Cut or Slicing of Wood: Plain sliced.
 - 3. Matching of Individual Leaves to Each Other: Book matching.
- B. Fully Concealed Surfaces: MDF. Particleboard is NOT acceptable.

2.2 COMPONENTS – LAMINATE CLAD MILLWORK

- A. Laminate: NEMA LD 3, GP50 for horizontal surfaces, GP28 for vertical surfaces, CL20 for cabinet liner surfaces.

1. Faces – Staff Lounge: Wilsonart, Pressed Linen 4991-38
2. Faces – All Other Laminate Clad: Wilsonart, Lowell Ash, 7994-38
3. Countertops: Wilsonart, Crisp Linen 4942-38

2.3 ACCESSORIES

- A. Concealed Joint Fasteners: Threaded steel.
- B. Wood Filler: Tinted to match surface finish color.
- C. Hardware:
 1. Hinges: Concealed style, nickel-plated steel finish.
 2. Pulls: Hardware Resources, Elements, Naples, #154SS; satin nickel finish.
 - a. Drawers: Install horizontally.
 - b. Doors: Install vertically.
 3. Latches: Concealed style, nickel-plated steel finish.
 4. Grommets: EDP with 2-1/2" hole; black finish. Mockett & Co. (800.523.1269)
 5. Shelf Standards: Recessed style, such as KV #255, zinc plated steel finish.
 6. Shelf Brackets: KV #256, zinc plated steel finish.
 7. Drawer Glides: Heavy duty, steel ball bearing, 100 lb. minimum, full extension.
 8. Waste Bin Glide: Hafele, Euro Cargo 45; pull-out, door mounted, 110 lb. capacity, with telescopic over extension ball bearing slides.

2.4 FABRICATION

- A. Fabricate to AWI Custom standards, unless noted otherwise.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install work in accordance with AWI Custom quality standard, unless noted otherwise.
- B. Set and secure materials and components in place, plumb and level.
- C. Cover exposed edges of wood veneered millwork with a 3/8 inch thick hardwood edging, where 1 x 2's are not shown. Taped edges are permissible only at edges of reveals.
- D. Install hardware and adjust for smooth operation.
- E. Preparation for Site Finishing (Wood Veneered Millwork):
 1. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
 2. Site Finishing: Refer to Section 09 90 00.

END OF SECTION

SECTION 06 61 16

SOLID SURFACING FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Cast plastic fabrications.
 - 1. Lavatory tops with undermount bowls.
 - 2. Millwork counter tops with undermount sinks and backsplashes.

1.2 PERFORMANCE REQUIREMENTS

- A. Performance/Design Criteria:

Property	Requirement Procedure (min or max)	Test Procedure
1. Solid Surface Based Products:		
a. Tensile Strength	6000 psi min	ASTM D638
b. Tensile Modulus	1.5 x 10 ⁶ psi min	ASTM D 638
c. Tensile Elongation	0.4% min	ASTM D638
d. Flexural Strength	10,000 psi min	ASTM D790
e. Flexural Modulus	1.2 x 10 ⁶ psi min	ASTM D790
f. Hardness	>85 Rockwell "M" scale	ASTM D785
g. Thermal Expansion	2.2 x 10 ⁻⁵ in/in/°F	ASTM E228
h. Fungi and Bacteria	Does not support	ASTM G21 & G22
i. Microbial Resistance	Highly resistant to mold	UL 2824
j. Ball Impact	No fracture – ½ lb. ball; 6 mm slab – 36" drop 12 mm slab – 144" drop	NEMA LD 3, Method 3.8
k. Weatherability	ΔE*94<5 in 1,000 hrs	ASTM G155
l. Flammability		ASTM E84, NFPA 255, BB & UL 723
m. Flame Spread	<25	
n. Smoke Developed	<25	
o. Class	A	NFPA 101, Life Safety Code

1.3 SUBMITTALS

- A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components.
 - 1. Show full-size details, edge details, thermoforming requirements, attachments, etc.
 - 2. Show locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in other Sections.

- B. Product Data: Indicate product description, fabrication information and compliance with specified performance requirements.
- C. Provide copy of fabricator's certification from manufacturer.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. Submit manufacturer's care and maintenance data, including repair and cleaning instructions.
 - 2. Include in project closeout documents.

1.4 QUALIFICATIONS

- A. Fabricator: Minimum 5 years experience in the application of products, systems and assemblies specified, with the approval and training by the manufacturer.

1.5 WARRANTY

- A. Furnish ten year manufacturer warranty.

1.6 MAINTENANCE

- A. Furnish two containers of polishing cream.

PART 2 PRODUCTS

2.1 PLASTIC FABRICATIONS

- A. Manufacturer/Style/Color: Formica, White Renew 748.

2.2 COMPONENTS

- A. Solid Polymer Components:
 - 1. Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6 having minimum physical and performance properties specified.
 - 2. Superficial damage to a depth of 0.010 inch (0.25 mm) shall be repairable by sanding and/or polishing.
 - 3. Flammability: UL 723; Class 1 and A.

2.3 ACCESSORIES

- A. Polishing Cream: Compatible polishing cream to achieve specified sheen to gel coat.
- B. Core Framing: As shown on Drawings.
- C. Adhesive: ASTM C920; one component silicone, approved by manufacturer, to create inconspicuous, nonporous joints.
- D. Sealant: Manufacturer's standard mildew-resistant FDA-compliant, NSF 51-compliant (food zone – any type), UL-listed silicone sealant in colors matching components.

2.4 FABRICATION

- A. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved Shop Drawings and solid polymer manufacturer requirements. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints. Provide factory cutouts for plumbing fittings as indicated on Drawings.
- B. Where indicated, thermoform corners and edges or other objects to shapes and sizes indicated on Drawings, prior to seaming and joining. Cut components larger than finished dimensions and sand edges to remove nicks and scratches. Heat entire component uniformly prior to forming.
- C. Ensure no blistering, whitening and cracking of components during forming.
- D. Fabricate backsplashes from solid surfacing material with optional radius cove where counter and backsplashes meet as indicated on Drawings.
- E. Fabricate joints between components using manufacturer's standard joint adhesive. Ensure joints are inconspicuous in appearance and without voids. Attach 50 mm (2") wide reinforcing strip of solid polymer material under each joint. Reinforcing strip of solid polymer material is not required when using DuPont™ Joint Adhesive 2.0
- F. Provide holes and cutouts for plumbing and bath accessories as indicated on Drawings.
- G. Rout and finish component edges to a smooth, uniform finish. Rout cutouts, then sand edges smooth. Repair or reject defective or inaccurate work.
- H. Finish: Ensure surfaces have uniform finish:
 - 1. Semi-gloss, with a 60° gloss rating of 25 - 50.
- I. Fabrication Tolerances:
 - 1. Variation in Component Size: +/-1/8".
 - 2. Location of Openings: +/-1/8" from indicated location.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify actual site dimensions and location of adjacent materials prior to commencing work.
- C. Examine cabinets upon which counter tops are to be installed. Verify cabinets are level to within 1/8" in 10' - 0".
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
- B. Provide product in the largest pieces available. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Exposed joints/seams shall not be allowed.
- C. Reinforce field joints with solid surface strips extending a minimum of 1 inch on either side of the seam with the strip being the same thickness as the top.
- D. Cut and finish component edges with clean, sharp returns. Rout radii and contours to template.
- E. Anchor securely to base cabinets or other supports.
- F. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop.
- G. Carefully dress joints smooth, remove surface scratches and clean entire surface.
- H. Install countertops with no more than 1/8-inch (3 mm) sag, bow or other variation from a straight line.
- I. Repair or replace damaged work which cannot be repaired to Architect's satisfaction.
- J. Seal between wall and components with joint sealant as specified herein and in Section 07 92 00, as applicable.
- K. Provide backsplashes and endsplashes as indicated on Drawings. Adhere to countertops using a standard color-coordinated silicone sealant. Adhere applied sidesplashes to countertops using a standard color-matched silicone sealant. Provide coved backsplashes and sidesplashes at walls and adjacent millwork. Fabricate radius cove at intersection of counters with backsplashes to dimensions shown on reviewed Shop Drawings. Adhere to countertops using manufacturer's standard color-coordinated joint adhesive.
- L. Coordinate connections of plumbing fixtures.

3.3 SITE QUALITY CONTROL

- A. Repair minor imperfections and cracked seams and replace areas of severely damaged surfaces in accordance with manufacturer's "Technical Bulletins".
- B. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Architect at no cost to Owner.

3.4 CLEANING AND PROTECTION

- A. Keep components and hands clean during installation.
- B. Remove adhesives, sealants and other stains.

END OF SECTION

SECTION 06 62 16

QUARTZ SURFACING FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes horizontal countertops, splashes and bullnoses.

1.2 DEFINITION

- A. Homogenous mixture containing 93% pure quartz with additions of high performance polyester resin pigments and special effects.

1.3 SYSTEM DESCRIPTION

- A. Performance characteristics:

Property	Typical Result	Test
Compressive Strength	24,750 psi	ASTM C170
Modulus of Rupture	6,800	ASTM C99
Bond Strength	205 psi	ASTM C482
Thermal Shock	passes 5 cycles	ASTM 484
Stain Resistance	Unaffected	ANSI Z124.6
Moisture Absorption	0.02%	ASTM C97
Moisture Expansion	<0.01	ASTM C370
Abrasion Resistance	223	ASTM C501
Coefficient of Thermal Expansion	$1.2 \times 10^{-5}/F$	ASTM C531
Breaking Strength of Tile	3661 lbf	ASTM 648
Resistance to Freeze Thaw Cycling	Unaffected 15 cycles	ASTM C1028
Coefficient of Friction Pull Method	0.75 avg. dry/0.55 avg. wet	ASTM C1028
Surface Burning Characteristics 17		ASTM E84
Smoke Density	Flaming 196, Non-flaming 69	ASTM E662

1.4 SUBMITTALS

- A. Product Data: Required.
- B. Shop Drawings:
 - 1. Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices and other components.
- C. Samples:
 - 1. For each type of product indicated.
 - a. Submit minimum 6-inch by 6-inch sample in specified gloss.
 - b. Cut sample and seam together for representation of inconspicuous seam.
 - c. Indicate full range of color and pattern variation.
 - 2. Approved samples will be retained as a standard for work.

- D. Fabricator/Installer Qualifications:
 - 1. Provide copy of certification number.
- E. Maintenance Data:
 - 1. Submit manufacturer's care and maintenance data, including repair and cleaning instructions.
 - 2. Include in project closeout documents.

1.5 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Shop that employs skilled workers who custom fabricate products similar to those required for this project and whose products have a record of successful in-service performance.
- B. Fabricator/installer Qualifications:
 - 1. Work of this section shall be by a certified fabricator/installer, certified in writing by the manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver no components to project site until areas are ready for installation.
- B. Store components indoors prior to installation.
- C. Handle materials to prevent damage to finished surfaces.
 - 1. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.7 WARRANTY

- A. Provide manufacturer's warranty against defects in materials.
 - 1. Warranty shall provide material and labor to repair or replace defective materials.
 - 2. Damage caused by physical or chemical abuse or damage from excessive heat will not be warranted.
 - 3. Warranty shall be transferable to subsequent owner for remainder of warranty period.
- B. Manufacturer's warranty period:
 - 1. Ten years from date of substantial completion.

1.8 MAINTENANCE

- A. Provide maintenance requirements as specified by the manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURER/COLOR

A. Manufacturer/Style: Wilsonart, North Cascades.

2.2 MATERIALS

A. Quartz Components: Homogenous mixture containing 93% pure quartz with additions of high performance polyester resin, pigments and special effects.

B. Thicknesses: 2 cm with 4 cm edge.

C. Edge treatment: As indicated on Drawings.

D. Finish: High gloss.

2.3 ACCESSORIES

A. Mounting Adhesive: Structural grade "50 year" silicone or epoxy adhesive.

B. Surface Adhesive: Epoxy or polyester.

C. Adhesive Manufacturers:

1. Cambria
2. Akemi North America
3. Bonstone Material Corp.
4. Tenax USA

D. Joint Sealant: Clear sealant of type recommended by manufacturer for application and use.

1. Manufacturers:
 - a. Dow Corning
 - b. GE Sealants

E. Solvents: Denatured alcohol for cleaning to assure adhesion of adhesives and sealants.

2.4 FABRICATION

A. Layout surfaces to minimize joints and avoid L-shaped pieces of quartz surfacing. Layout and fabricate with hairline joints.

B. Inspect materials for defects prior to fabrication.

C. Cut and polish with water cooled powered tools.

D. Cutouts to have minimum of 3/8 inch radius.

E. Where edges of cutouts will be exposed in finished work, polish edges.

F. Laminate layers of quartz surfacing as required to create built up edges following procedures recommended by the manufacturer.

G. Fabrication must be by a certified fabricator, certified in writing by the manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify dimensions by field measurements prior to installation.
- C. Verify that substrates supporting quartz surfaces are plumb, level and flat to within 1/8 inch in 10 feet and that all necessary supports and blocking are in place.
- D. Clean surfaces prior to installation. Protect finished surfaces from scratches. Apply masking where necessary. Take necessary precautions to prevent dirt, grit, dust and debris from other trades from contacting the surface.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Installation must be by a certified installer, certified in writing by the manufacturer.
- B. Install materials in accordance with manufacturer's instructions and approved shop drawings.
- C. Position materials to verify the correct size. If size adjustments or additional fabrication is necessary, use water cooled tools. Protect jobsite and surface from dust and water.
- D. Allow gaps for expansion of not less than 1/8 inch per ten feet when installed between walls or other fixed structure.
- E. Clean substrate. Remove loose and foreign matter which may interfere with adhesion. Clean backside and joints with denatured alcohol. Apply continuous bead of mounting adhesive around perimeter of structural substrate and supports on horizontal surface. Apply continuous bead of mounting adhesive around perimeter of vertical surfaces. In addition, apply ¼ inch mounting adhesive bead every 8 inches on vertical center.
- F. Install quartz surfacing plumb, level, square and flat to within 1/8 inch in ten feet, non-cumulative. Align adjacent pieces in same plane.
- G. Joints:
 - 1. Joints between Adjacent Pieces of Quartz Surfacing:
 - a. Joints to be flush, tight fitting, level and neat.
 - b. Securely join adjacent pieces with two part acrylic adhesive.
 - c. Fill joints level to polished surface.
 - d. Secure adjacent quartz surfaces with vacuum clamps until adhesive hardens.

2. Joints Between Quartz Surface and Backsplash: Seal joints with silicone sealant.

3.3 REPAIR

- A. Replace or repair damaged material to like new condition.

3.4 CLEANING AND PROTECTION

- A. Remove masking, excessive adhesive and sealants. Clean exposed surfaces with denatured alcohol.
- B. Protect installed fabrications with non-staining sheet coverings.

END OF SECTION

SECTION 07 10 00

WATER REPELLENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Water repellent coating applied to exterior brick and cast stone surfaces.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit details of product description, tests performed, limitations to coating, and chemical properties including percentage of solids.
- C. Manufacturer's Installation Instructions: Submit special procedures and conditions requiring special attention, and cautionary procedures required during application.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience, approved by manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Protect coating liquid from freezing.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not apply coating when temperature is lower than 40 degrees F or higher than 100 degrees F.
- C. Do not apply coating when wind velocity exceeds manufacturer recommendations.

1.6 WARRANTY

- A. Section 01 70 00 - Execution Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for water repellents.

PART 2 PRODUCTS

2.1 WATER REPELLENTS

- A. Manufacturers:
 - 1. Chemprobe Technologies, Prime-A-Pell 200
 - 2. ProSoCo, Sure Klean Weatherseal.
 - 3. Substitutions: Section 01 60 00 - Product Requirements.

- B. Siloxane Water Repellent: Siloxane penetrating type water repellent, prediluted.
 - 1. Moisture Vapor Transmission: Maximum 28.33 perms or 50% compared to untreated surfaces, ASTM D1653.
 - 2. Resistance to Accelerated Weathering: No loss in repellency after 2,500 hours, ASTM G154.
 - 3. Reduction of Leakage: Minimum 97 percent water penetration and leakage, ASTM E514.
 - 4. Apply to brick and cast stone surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify joint sealants are installed and cured.
- C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of coatings.
- D. Do not apply waterproofing to damp, frozen, dirty, or dusty surfaces.

3.2 PREPARATION

- A. Delay Work until masonry mortar substrate is cured minimum of 60 days.

3.3 APPLICATION

- A. Apply Work in accordance with manufacturers' instructions.
- B. Apply water repellent at rate recommended by manufacturer. Apply in dry, fair weather when the air and surface temperatures are above 25 degrees F. Do not apply to frozen concrete.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 - Execution Requirements: Protecting installed construction.
- B. Protect adjacent surfaces not scheduled to receive coating.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Board thermal insulation at perimeter foundation wall.
 - 2. Batt thermal insulation in exterior wall construction.

- B. Related Sections:
 - 1. Section 07 21 20: Exterior Insulated Sheathing
 - 2. Section 09 26 00: Gypsum Board Systems for sound batts.

1.2 SUBMITTALS

- A. Product Data: Required.

1.3 QUALITY ASSURANCE

- A. Insulation Installed in Concealed Locations Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84 and NFPA 285.

- B. Apply label from agency approved by authority having jurisdiction to identify each insulation material.

PART 2 PRODUCTS

2.1 BUILDING INSULATION

- A. Extruded Polystyrene Insulation: ASTM C578 Type VI, cellular type.
 - 1. Foundation: Dow Styrofoam Square Edge
 - a. Thermal Resistance: R of 10.
 - b. Thickness: 2 inches at foundation.
 - c. Compressive Strength: Minimum 25 psi.
 - d. Edges: Square.
 - e. ASTM C578 Type IV: Meets IBC/IRC requirements for foam plastic insulation.

- B. Batt Insulation: ASTM C665, preformed mineral fiber.
 - 1. Thermal Resistance: R of 19.
 - 2. Facing: Kraft paper.

2.2 ACCESSORIES

- A. Adhesive: Type recommended by insulation manufacturer for application.

- B. Tape: Self-adhering type.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Foundation Perimeter - Board Insulation:
 - 1. Adhere polyethylene sheet over substrate joints.
 - 2. Apply adhesive and install boards on foundation perimeter.
 - 3. Place protective boards over exposed insulation surface.

- B. Batt Insulation:
 - 1. Install in exterior walls spaces without gaps or voids.
 - 2. Attach flanges of facing to framing members.

END OF SECTION

SECTION 07 21 20

EXTERIOR INSULATED SHEATHING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Exterior insulated wall sheathing with integral water-resistive barrier and air barrier.
- B. Related Sections:
 - 1. Section 07 21 00: Thermal Insulation
 - 2. Section 09 21 16: Gypsum Board Assemblies (for interior insulation)

1.2 SUBMITTALS

- A. Product Data: For each type of product specified.

1.3 CLOSEOUT SUBMITTALS

- A. Warranty: Executed copy of manufacturer special warranties.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for protection of sheathing products from weather prior to installation.
- B. Weather Exposure: Manufacturer warranty applies for maximum allowable exposure period of 180 days.
- C. Flashing and Sealant: Surface and ambient temperatures should be 35°F and rising and below 120°F during application. LIQUIDARMOR™ -CM Flashing and tolerates rain if adequate skin forms before rain exposure. Exact time varies depending on temperature and humidity conditions. In low temperature, high humidity (> 50% R.H.) applications, allow LIQUIDARMOR™- CM to cure for at least 24 hours. However, do not apply to surfaces with standing water or frost.

1.5 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard 15 year warranty.

PART 2 PRODUCTS

2.1 SHEATHING - MANUFACTURER

- A. Basis-of-Design Product: DOW, Thermax XArmor.
- B. Substitutions: Refer to Section 01 60 00.
- C. Description: Rigid board insulation consisting of glass-fiber-infused polyisocyanurate foam core laminate between 1.0 mil smooth, reflective aluminum facers on interior and 4.0 mil embossed, acrylic-coated aluminum facer on the exterior.

1. Water Vapor Permeance: ASTM E96 - <0.04
2. Water Absorption: ASTM C209 - 0.1.
3. Water Penetration: : Tested in accordance with ASTM E331, with minimum pressure differential of 6.24 psf (300 Pa) for at least two hour test duration without any uncontrolled water penetration.
4. Air Infiltration: ASTM E2357 at a test pressure of 6.24 psf; less than 0.04 cfm / sq. ft.
5. Flexural Strength: ASTM C203; 55 psi min.
6. Flame Spread/Smoke Development Ratings: 25/<450.
7. R Value: 6.5.

D. Size:

1. Sheet Size: 4' x 8'.
2. Thickness: 1 inch.

E. Flashing and Sealant: LiquidArmor.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine framing spacing and alignment to determine if work is ready to receive insulation. Proceed with work once conditions meet requirements.
- B. Treat any gaps in Thermax sheathing greater than ¼" wide with insulating foam (GREAT STUFF PRO) or caulk.

3.2 INSTALLATION

- A. Install panels in accordance with manufacturer's written instructions, and requirements of authorities having jurisdiction.
- B. Coordinate installation with flashing and joint sealant sequencing and installation to provide complete, continuous air- and moisture- barrier.
- C. Do not compress insulation to fit into spaces.
- D. Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- E. Keep insulation minimum 3" from heat emitting devices such as recessed light fixtures, and minimum 2" from sidewalls of chimneys and vents.
- F. Apply tape at all panel seams, penetrations, gaps, and cracks, to form continuous weathertight surface. Apply according to manufacturer's written instructions.

END OF SECTION

THERMOPLASTIC-POLYOLEFIN ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Adhered membrane roofing system.
 - 2. Cover board.
 - 3. Rigid insulation board.
 - 4. Roof hatch.
 - 5. Walkway protection pads.

1.2 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 "Terminology Relating to Roofing and Waterproofing"; glossary of NRCA's "The NRCA Roofing and Waterproofing Manual"; and the Roof Consultants Institute "Glossary of Roofing Terms" for definition of terms related to roofing work in this Section.
- B. Sheet Metal Terminology and Techniques: SMACNA Architectural Sheet Metal Manual.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and Flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. Jobsite Safety: Execute all operations and provide a safe work environment in accordance to OSHA standards and regulations. This requirement applies to all contractor personnel, associated subcontractors, workers in other trades, and jobsite visitors.
 - 1. Follow all industry fire prevention guidelines for storage of materials, staging areas, roof access, and application means and methods.
 - 2. Any applicable local fire codes supersede industry guidelines.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.
 - 1. Flashings and membrane terminations.
 - 2. Insulation fastening patterns.
 - 3. Sheet layout with perimeter and corner defined.

- C. Installer Certificates:
 - 1. Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system as specified. Provide documentation complying with "Quality Assurance" as specified in Paragraph 1.6 of this Section.
 - 2. Installer shall submit documentation that there are no undocumented workers being employed by their company and that all workers on this project are covered by workmen's compensation.
- D. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of meeting performance requirements.
- E. Qualification Data: For Installer and manufacturer.
- F. Maintenance Data: For roofing system to include in maintenance manuals.
- G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive the specified manufacturer's warranty.
- B. Manufacturer Qualifications: A qualified manufacturer for membrane roofing system identical to that used for this Project.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain all components from single source roofing manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

- E. Keep all adhesives, sealants, primers and cleaning materials away from all sources of ignition.
- F. Consult container labels and material safety data sheets (MSDS) for specific safety instructions.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.8 WARRANTY

- A. Comply with all warranty procedures required by manufacturer, including notifications, scheduling, and inspections.
- B. Red Shield no dollar limit, non-prorated warranty from the manufacturer of the roofing membrane as follows with no exceptions.
 - 1. Warranty coverage: 20-years, no dollar limit.
 - 2. Warranty shall be transferable and transfer cannot be at manufacturer's discretion nor require an inspection but shall be transferable upon notification in writing to manufacturer and payment of the standard transfer fee.
 - 3. Warranty coverage to include: roofing membranes, insulation, fasteners, clips, adhesives, accessories, and edge metal/coping system.
 - 4. The warranty shall cover metal finishes, materials, labor and correct and incorrect workmanship on system installation, seaming and/or flashing. Manufacturer cannot exclude unapproved details or workmanship. Also includes accidental cuts and punctures
 - 5. All roofing systems tie-ins, flashing and terminations must be covered under the Warranty.
 - 6. Warranty will begin upon completion of the project and warranty application procedures and cannot defer warranty coverage to installing contractor for any period of warranty coverage.
- C. Inspect roof system at completion of installation. Manufacturer cannot deny coverage for any items not installed in compliance with manufacturer's application requirements and standards after warranty is issued or as a part of terms and conditions of the warranty. The manufacturer's technical field representative/inspector will conduct final inspections. The manufacturer field representative must be a non-sales employee of the roofing system manufacturer who is responsible for field quality control and contractor training.
- D. General Contractor and Roofing Subcontractor: Required to jointly and separately provide written guarantee that the roofing and flashing will be weathertight and free from defects in materials and workmanship for a period of 2 years from Final Acceptance Date.
 - 1. Leaks and defects include blistering, fishmouths, ridging, splits, open laps, buckles, wrinkles and slippage. Make corrections at Contractor's expense during guarantee period.
 - 2. Roofing inspection and written acceptance by manufacturer, Architect, and Owner will be required. In addition, roofing subcontractor is to schedule a joint inspection by above named parties 60 days prior to expiration of 2 year guarantee and correct defects complying with original specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Manufacturer: Holcim Elevate (formerly Firestone).
- B. Description: Reinforced, ULTRAPLY TPO synthetic single-ply membrane composed of Thermoplastic Polyolefin polymer, and Ethylene Propylene Rubber.
 - 1. Membrane Type: .060 Reinforced TPO OR .060 Reinforced TPO SA

Testing	Minimum Values	Typical values (SI Units)
Thickness, min, mm (in.)		
Sheet-overall	1.0 (0.039)	0.060± 10%
Coating over scrim	0.015"	0.021" ± 10%
Tensile strength, min, MPa (psi)	NA	
Breaking strength, min, kN (lbf)	220 lbf	390 lbf
Elongation, ultimate, min, %	NA	
Elongation at break, min, %	15%	25%
Tensile set, max, %	NA	
Tear strength, min, kN/m (lbf/in.)	NA	
Tearing strength, min, N (lbf)	55 lbf	120 lbf
Brittleness point, max, °C (°F)	-40	Pass
Ozone resistance, no cracks	Pass	Pass
Properties after heat aging: (retained values)		
Tensile strength, % min	NA	
Breaking strength, % min	90%	90%
Elongation, ultimate, % min	NA	
Elongation at break, % min	90% ^A	90%
Tear strength, % min	NA	
Tearing strength, % min	60% min	>60%
Weight Change (Mass), max %	±1% max	<1%
Linear dimensional change, max, %	±1% max	<1%
Water absorption, max, mass %	±3%	<3%
Factory seam strength, min, kN/m (lbf/in.)	75% of Sheet strength	75% of Sheet strength

2.2 AUXILIARY MATERIALS

- A. Membrane Adhesive: UltraPly Bonding Adhesive; Butyl-based, formulated for compatibility with the ULTRAPLY TPO membrane and a wide variety of substrate materials, including masonry, wood, insulation facings.
- B. Curb and Parapet Flashing: Same material as membrane, with encapsulated edge which

eliminates need for seam sealing the flashing-to-roof splice; precut to 18 inches (457 mm) wide.

- C. Formable Flashing: Non-reinforced, flexible, heat weldable sheet, composed of thermoplastic polyolefin polymer and ethylene propylene rubber.
 - 1. Thickness: 0.060 inch plus/minus 10 percent.
 - 2. Tensile Strength: 1550 psi (10.7 MPa), minimum, when tested in accordance with ASTM D 638 after heat aging.
 - 3. Elongation at Break: 650 percent, minimum, when tested in accordance with ASTM D 638 after heat aging.
 - 4. Tearing Strength: 12 lbf (53 N), minimum, when tested in accordance with ASTM D 1004 after heat aging.
 - 5. Color: White.
 - 6. Acceptable Product: ULTRAPLY TPO Flashing by Firestone.
- D. Tape Flashing: 5-1/2 inch (140 mm) nominal wide TPO membrane laminated to cured rubber polymer seaming tape, overall thickness 0.065 inch (1.6 mm) nominal; TPO QuickSeam Flashing by Firestone.
- E. Pourable Sealer: Two-part polyurethane, two-color for reliable mixing; Pourable Sealer by Firestone.
- F. Seam Plates: Steel with barbs and Galvalume coating; corrosion-resistance complying with FM 4470.
- G. Termination Bars: Aluminum bars with integral caulk ledge; 1.3 inches (33 mm) wide by 0.10 inch (2.5 mm) thick; Firestone Termination Bar by Firestone.
- H. Cut Edge Sealant: Synthetic rubber-based, for use where membrane reinforcement is exposed; UltraPly TPO Cut Edge Sealant by Firestone.
- I. General Purpose Sealant: EPDM-based, one part, white general purpose sealant; UltraPly TPO General Purpose Sealant by Firestone.
- J. Molded Flashing Accessories: Unreinforced TPO membrane pre-molded to suit a variety of flashing details, including pipe boots, inside corners, outside corners, etc.; UltraPly TPO Small and Large Pipe Flashing by Firestone.
- K. Walkways: Firestone UltraPly TPO Walkway material.

2.3 ROOF INSULATION AND COVER BOARDS

- A. Tapered Polyisocyanurate Board Insulation: Tapered, closed cell polyisocyanurate foam with glass-reinforced mat laminated to faces, complying with ASTM C 1289 Type I Class 1, with the following additional characteristics:
 - 1. Thickness: As required to meet minimum R20; minimum 2 layers.
 - 2. Size: 48 inches by 48 inches, nominal.
 - 3. Compressive Strength: 20 psi (138 kPa) when tested in accordance with ASTM C1289.
 - 4. Ozone Depletion Potential: Zero; made without CFC or HCFC blowing agents.
 - 5. Recycled Content: 19 percent post-consumer and 15 percent post-industrial, average.
 - 6. Attachment: Fully adhered.

- B. Cover Board: Dens Deck with the following additional characteristics:
 - 1. Size: 48 inches by 96 inches, nominal.
 - 2. Thickness: 1/4".
 - 3. Water Absorption: ASTM C 209.
 - 4. Water Vapor Transmission of Materials: ASTM E 96.
 - 5. Compressive Strength: ASTM D 1621.
 - 6. Density: ASTM D 1622.
 - 7. Dimensional Stability: ASTM D 2126.
 - 8. Flame Spread: ASTM E 84.
 - 9. Attachment: Mechanical fastening thru insulation board into roof deck.

2.4 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Provide factory preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and provided by roofing system manufacturer.
- D. Crickets: ASTM C 1289; provide factory-tapered insulation boards fabricated to slope of ¼" per foot unless otherwise indicated. Product must be manufactured by company providing roofing system warranty.

2.5 ACCESSORY MATERIALS

- A. Wood Nailers: PS 20 dimension lumber, Structural Grade No. 2 or better Southern Pine, Douglas Fir; or PS 1, APA Exterior Grade plywood; pressure preservative treated in accordance with Section 06 10 00.
 - 1. Width: 3-1/2 inches nominal minimum, or as wide as the nailing flange of the roof accessory to be attached to it.
 - 2. Thickness: Same as thickness of roof insulation.
 - 3. Reference Standards:
 - a. Southern Pines: PS 20; SPIB Grading Rules.
 - b. Western Woods: PS 20; WWPA Grading Rules
 - c. Plywood: PS 1; APA Grade Stamps.
 - d. Pressure preservative treatment: AWPB LP2.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- C. Roof Hatch: Bilco Model S, 30" x 36", 11 gage aluminum, with Ladder-UP safety post, or approved equal.
- D. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine roof deck to determine that it is sufficiently rigid to support roofers and their mechanical equipment and that deflection will no strain or rupture roof components or deform deck.
- B. Verify that surfaces and site conditions are ready to receive work. Correct defects in the substrate before commencing with roofing work.
- C. Examine roof substrate to verify that it is properly sloped to drains.
- D. Start work with sealants and adhesives at 60° - 80° F.
- E. Fumes from adhesive solvents may be drawn into the building during installation through rooftop intakes. Appropriate measures must be taken to assure that fumes from adhesive solvents are not drawn into the building through air intakes.
- F. The surface must be clean, dry, smooth, free of sharp edges, fins, loose or foreign materials, oil, grease and other materials that may damage the membrane, All roughened surfaces, which could cause damage, shall be properly repaired before proceeding.
- G. All surface voids of the immediate substrate greater than 1/4" wide must be properly filled with an acceptable insulation or suitable fill material.

3.2 PROTECTION OF OTHER WORK

- A. Protect metal, glass, plastic, and painted surfaces from adhesives and sealants.
- B. Protect neighboring work, property, cars, and persons from spills and overspray from adhesives, sealants and coatings and from damage related to roofing work.
- C. Protect finished areas of the roofing system from roofing related work traffic and traffic by other trade.

3.3 PREPARATION

- A. Proceed with installation only after unsatisfactory conditions have been corrected. Beginning of installation constitutes acceptance of substrate and all conditions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 INSULATION AND COVER BOARD INSTALLATION

- A. General:
 - 1. Install only as much insulation as can be covered with the completed roofing system before the end of the day's work or before the onset of inclement weather.
 - 2. Lay roof insulation in courses parallel to roof edges.
 - 3. Neatly fit insulation to all penetrations, projections, and nailers. Fit insulation tightly, with gaps not greater than 1/4". Fill all gaps greater than 1/4" with acceptable insulation. Under no circumstances shall the roofing membrane be left unsupported over a

space greater than 1/4". Install tapered insulation around roof drains so as to provide proper slope for drainage. Miter roof insulation edges at ridge, valley and other similar non-planar conditions.

4. Stagger all joints between layers at least 6 in.
- B. Attach base layer, top layer, crickets, and cover board with Firetone Insulation Adhesive at a rate specified by the roofing manufacturer to meet the required Warranty requirements.
- C. Place board into the adhesive while it is still tacky. If adhesive reaches its tack-free state, remove and re-apply adhesive.
- D. Press the thermal protective layer into the adhesive to a firm and uniform bearing.
 1. Use ballast on all four corners of the board for a minimum of 30 minutes to ensure contact of material and adhesive, if necessary.
- E. Comply with membrane roofing system manufacturer's written instructions for installing roof cover board.
- F. Install cover board with long joints of cover board in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with cover board.
 1. Cut and fit cover board within 1/4 inch of nailers, projections, and penetrations.
- G. Trim surface of cover board where necessary at roof drains so completed surface is flush and does not restrict flow of water.
 1. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

3.5 ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.
- B. Starting at the low point of the roof, place the membrane panels without stretching over the acceptable substrate. Position subsequent membrane sheets in the same manner, overlapping the ends of adjoining sheets a minimum of 3" and side laps a minimum of 6". Install panels to ensure that laps shed water.
- C. Where UltraPly TPO Membrane has been cut to expose reinforcing membrane, Firestone's UltraPly TPO Cut Edge Sealant or UltraPly TPO General Purpose Sealant must be used to encapsulate exposed edge.

3.6 MEMBRANE LAP SPLICING

- A. Lap splice areas that have been contaminated must be wiped down with a dry or damp (water only) clean cloth prior to heat welding and allow to completely dry.
- B. All field and flashing splices on the horizontal surface shall be completed using an automatic heat welder that has been designed for hot air welding of thermoplastic Olefin membranes.

- C. Hand held welders are only to be used on vertical welds or where an automatic welder is not practical or cannot be used.
- D. Seams made with the automatic welder shall be a minimum of 1-1/2" wide. Seams made with hand welders shall be a minimum of 2" wide. Use 2" side silicone or silicone coated steel hand rollers to assure proper mating of surfaces as hand heat welding proceeds.
- E. Probe all completed welds using a slotted screwdriver or cotter pin puller type tool to verify seam integrity. Do not probe welds until they have had time to cool to ambient conditions. Any welds found to be insufficiently welded need to be repaired on a daily basis.

3.7 MEMBRANE SECUREMENT

- A. Secure membrane at all locations where the membrane terminates or goes through an angle change greater than 1" in 12" except for round pipe penetrations less than 18" in diameter and square penetrations less than 4" square.
 - 1. Mechanically fasten Firestone Seam Plates with Firestone Fasteners in accordance with Firestone Details.
 - 2. Install UltraPly membrane as flashing.

3.8 FLASHING - PENETRATIONS

- A. General:
 - 1. Flash all penetrations passing through the membrane.
 - 2. The flashing seal must be made directly to the penetration.
- B. Pipes, Round Supports, etc.:
 - 1. Flash with Firestone Pre-Molded UltraPly TPO Pipe Flashings where practical
 - 2. Flash using UltraPly TPO unsupported Flashing membrane when Pre-Molded Flashing is not practical.
- C. Structural Steel Tubing:
 - 1. Use a field fabricated pipe-flashing detail provided that the minimum corner radius is greater than 1/4" and the longest side of the tube does not exceed 12". When the tube exceeds 12: use a standard curb detail.
- D. Roof Drains:
 - 1. Provide a clean even finish on the mating surfaces between the clamping ring and the drain bowl.
 - 2. Taper insulation around the drain to provide a smooth transition from the roof surface to the drain. Use pre-manufactured tapered insulation with facer or suitable bonding surface to achieve slope. Slope shall not exceed Firestone recommendations.
 - 3. Position the UltraPly TPO membrane, then cut a hole for the roof drain to allow 1/2" - 3/4" of membrane extending inside the clamping ring past the drain bolts.
 - 4. Make round holes in the UltraPly TPO membrane to align with clamping bolts. Do not cut the membrane back to the bolt holes.
 - 5. Place Water Block Seal on top of drain bowl where the clamping ring seats below membrane.
 - 6. Install the roof drain clamping ring and clamping bolts. Tighten the clamping bolts to achieve constant compression.

- E. Pipe Clusters and Unusual Shaped Penetrations:
 - 1. Fabricate penetration pockets to allow a minimum clearance of 1" between the penetration and all sides.
 - 2. Secure penetration pockets per Firestone Details.
 - 3. Fill penetration pockets with Pourable Sealer, so as to shed water.
- F. Hot Pipes:
 - 1. Protect the UltraPly TPO components from direct contact with steam or heat sources when the in-service temperature is in excess of 140 °F. In all such cases flash to an intermediate insulated "cool" sleeve per Firestone details.
- G. Flexible Penetrations:
 - 1. Provide a weather tight gooseneck set in Water Block Seal and secured to the deck.
 - 2. Flash in accordance with Firestone Details.

3.9 FLASHING - WALLS, PARAPETS, MECHANICAL EQUIPMENT, CURBS

- A. General: Using the longest pieces practical, flash all walls, parapets, curbs, etc., a minimum of 8" high per Firestone Details.
- B. Evaluate the substrate and overlay per Firestone specifications as necessary.
- C. Apply UltraPly TPO Bonding Adhesive at about the same time to both the membrane flashing and the surface to which it is being bonded so as to allow approximately the same drying time. Apply Bonding Adhesive by rolling the adhesive on to the mating surfaces evenly, avoiding globs or puddles.
- D. Allow UltraPly TPO Bonding Adhesive to flash off until tacky. Touch the Bonding Adhesive surface with a clean, dry finger to be certain that the adhesive does not stick or string. As you are touching the adhesive, pushing straight down to check for stringing, also push forward on the adhesive at an angle to ensure that the adhesive is ready throughout its thickness. If either motion exposes wet or stringy adhesive when the finger is lifted, then it is not ready for mating. Flash off time will vary depending on ambient air conditions.
- E. Roll the flashing into the adhesive evenly and carefully so as to minimize wrinkles.
- F. To ensure proper contact, compress the flashing to the substrate with a stiff push broom.
- G. Complete the splice between membrane flashing and the main roof sheet by hot air welding. Provide lap splices in accordance with Firestone Details.
- H. Provide termination directly to the vertical substrate as shown in Firestone Details.
- I. Install UltraPly TPO T-Joint covers at field and flashing splice intersections as required by Firestone.
- J. Install intermediate flashing attachment as required by Firestone Specifications and Details.

3.10 FLASHING - GRAVEL STOPS OR ROOF EDGE METALS

- A. Flash all gravel stops or roof edges using as outlined in Firestone Details.

3.11 TEMPORARY CLOSURE

- A. Temporary closures, which ensure that moisture does not damage any completed section of the new roofing system, are the responsibility of the roofing contractor. Completion of flashings, terminations, and temporary closures shall be completed as required to provide a watertight condition.

3.12 ROOF WALKWAYS

- A. Heat weld the perimeters of the walkway material to the UltraPly TPO membrane per Firestone specifications. Refer to Drawings for location.

3.13 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed as required by the manufacturer.
- B. Correct identified defects or irregularities.

3.14 CLEAN-UP

- A. Clean all contaminants from building and surrounding areas.
- B. Remove trash, debris, equipment from project site and surrounding areas.
- C. Repair or replace damaged building components or surrounding areas to the satisfaction of the building owner.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flashings and counterflashings.
 - 2. Fabricated sheet metal items.
- B. Related Sections:
 - 1. Section 07 53 00: TPO Roofing

1.2 DESIGN REQUIREMENTS

- A. Sheet Metal Flashings: Conform to the following criteria of SMACNA "Architectural Sheet Metal Manual."

1.3 SUBMITTALS

- A. Product Data: Required.
- B. Samples: Required.

1.4 WARRANTY

- A. Provide manufacturer's guarantee for exterior color finish for a period of 20 years against blistering, peeling, cracking, flaking, checking, chipping and excessive color change and chalking. Color change not to exceed 5 N.B.S. units (per ASTM D-2244.64T) and chalking not less than rating of 8 per ASTM D-659.
- B. Guaranty: Guaranty sheet metal work installed under this Section against leakage or defects for 2 years after substantial completion date. Make good at Contractor expense or defects occurring within this period.

PART 2 PRODUCTS

2.1 SHEET METAL FLASHING AND TRIM

- A. Manufacturers:
 - 1. PacClad
 - 2. ColorKlad
 - 3. Berridge
 - 4. Substitutions: Permitted.
- B. Pre-Finished Galvanized Steel Sheet: ASTM A755/A755M; structural steel sheet, G90 (Z275) zinc coating; 24 gage core steel, shop pre-coated with two coat fluoropolymer top coat; color as selected by Architect.

2.2 ACCESSORIES

- A. Fasteners: All metal counter flashing and parapet cap flashing shall be attached with galvanized or cadmium plated screws with neoprene washers. Nails, screws and rivets used at other locations are to be the appropriate type for the purpose as described in the latest edition of the SMACNA Design Manual.
- B. Roofing Cement: F.S. SS-C-153, Type I, Class A (summer grade) or Class B (winter grade) as applicable.
- C. Underlayment: ASTM D226; Type II, No. 30 unperforated asphalt felt.
- D. Protective Backing Paint: FS TT-C-494, Bituminous.
- E. Sealant: Type specified in Section 07 90 00.
- F. Plastic Cement: ASTM D4586, Type I.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Form sheet metal accurately to dimensions and shapes required, watertight and weathertight, with angles and broken surfaces true, sharp, and in straight lines. Produce flat surfaces free from waves and buckles.
- B. Expansion: Allow a 3/8"-1/2" gap in coping caps between each section. Use 3-1/2" wide prefinished 24 gage cover plate over joints.
 - 1. Set cover plates in visible bead of polyurethane sealant between the cap and cover plate. Wipe joints of excessive sealant.
 - 2. Attach cover plate at the front and back with hex head cadmium screws with neoprene washers, installed in the gap between the metal cap sections.
 - 3. Do not exceed maximum length of 10'-0" for cap, fascia and flashing sections. Furnish with factory formed slots or enlarged holes for fasteners.
- C. Paint metal in contact with mortar, concrete, and masonry materials with an alkali resistant coating. Use heavy-bodied bituminous paint or approved equal.

3.2 MISCELLANEOUS FLASHING

- A. General:
 - 1. Where exposed portions are used as a counter-flashings, lap base flashings at least four inches and use thickness of metal as specified for exposed locations.
 - 2. Exposed edge of flashing may be formed as a receiver for two piece counter flashing.
 - 3. Terminate exterior edge beyond face of wall approximately 1/4-inch with drip edge where not part of counter flashing.
 - 4. Turn back edge up 1/4-inch unless noted otherwise where flashing terminates in mortar joint or hollow masonry unit joint.

5. Terminate interior raised edge in masonry backup unit approximately 2 inches into unit unless shown otherwise.
6. Under copings terminate both edges beyond face of wall approximately 1/4-inch with drip edge.
7. Lap end joints not less than four inches. Seal laps with sealant.
8. Where dowels, reinforcing bars and fastening devices penetrate flashing, seal penetration with sealing compound.
9. Coordinate with other work to set in a bed of mortar above and below flashing so that total thickness of the two layers of mortar and flashing are same as regular mortar joint.
10. Where ends of flashing terminate turn ends up 1 inch and fold corners to form dam extending to wall face in vertical mortar or veneer joint.
11. Turn flashing up not less than 8 inches between masonry wythes or behind exterior veneer.
12. Secure flashings in place using concealed fasteners.
13. Seal metal joints watertight.

END OF SECTION

SECTION 07 90 00

JOINT PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sealants and joint backing.
 - 2. Precompressed foam sealers.
 - 3. Hollow gaskets.
 - 4. Accessories.

- B. Furnish labor, materials, tools, and equipment required to completely close (with caulking compound or sealant) all joints to give a finished appearance. Items to be caulked or sealed include but are not limited to the following:
 - 1. Hollow metal frames.
 - 2. Exterior doors, louvers, windows and any other openings in exterior walls.
 - 3. Interior fixed glass.
 - 4. Penetrations by piping, conduit and similar items.
 - 5. Plumbing fixtures.
 - 6. Millwork.
 - 7. Flooring, paving and sidewalk joints.
 - 8. Dissimilar finishes.
 - 9. Joints shown on drawings or specified to be caulked or sealed.
 - 10. All joints or gaps between similar or dissimilar materials that do not receive closure trim are to be caulked/sealed with the appropriate material as listed in Part 2 of this Section.

1.2 SUBMITTALS

- A. Product Data: Required.
- B. Samples: Required.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.4 WARRANTY

- A. Furnish to the Architect, in duplicate, the following written guarantee before final payment will be made for Work under this part of the Contract:

"This firm guarantees to promptly repair and replace, without further cost to the Owner, the whole or any part of the materials which prove defective through workmanship or improper materials within 2 years of the date of final acceptance. This includes damage

to the building caused by defective workmanship and/or improper materials or that which is caused by repair or replacement of defective materials or workmanship."

PART 2 PRODUCTS

2.1 JOINT SEALERS

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Pecora Corp.
 - 3. Tremco Sealants & Waterproofing.
 - 4. Substitutions: Permitted.
- B. High Performance General Purpose Exterior (Nontraffic) Sealant: Silicone such as Dow 790 or approved equal; ASTM C920 non-sag.
- C. General Purpose Traffic Bearing Sealant : Polyurethane; ASTM C920, pourable. Refer to civil specifications.
- D. Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, non-drying, non-skinning, non-curing.
- E. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.

2.2 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer.
- C. Joint Backing: Round foam rod compatible with sealant.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify substrate surfaces and joint openings are ready to receive work. Beginning of installation constitutes acceptance of conditions.
- B. Verify joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter impairing adhesion of sealant.
- B. Clean and prime joints.

- C. Perform preparation in accordance with ASTM C1193.
- D. Protect elements surrounding Work of this section from damage or disfiguration.

3.3 INSTALLATION

- A. Perform installation in accordance with ASTM C1193.
- B. Perform acoustical sealant application work in accordance with ASTM C919.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Tool joints concave.
- G. Precompressed Foam Sealant: Install with face 1/8 to 1/4 inch below adjoining surface.
- H. Compression Gaskets: Install with face 1/8 to 1/4 inch below adjoining surface.
- I. Seal all interior joints where unlike materials meet and joints do not close tight. Finish smooth with adjacent surfaces, suitable for painting.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel doors and frames; non-rated.
 - 2. Interior borrowed light frames.

1.2 SUBMITTALS

- A. Shop Drawings: Required.
- B. Product Data: Required.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
 - 1. ANSI 250.8 – Recommended Specifications for Standard Steel Doors and Frames.
 - 2. DHI – Door Hardware Institute – The Installation of Commercial Steel doors and Steel Frames, Insulated Steel Doors in Wood Frames, and Builder’s Hardware.
- B. Conform to requirements of ANSI A250.8.

PART 2 PRODUCTS

2.1 STEEL DOORS AND FRAMES

- A. Manufacturers:
 - 1. Amweld Building Products, Inc.
 - 2. Ceco Door Products
 - 3. Republic Doors
 - 4. Steelcraft
 - 5. Substitutions: Not Permitted.

2.2 COMPONENTS

- A. Doors (Insulated): ANSI A250.8, SDI 108, 1-3/4 inch thick; 18 gage.
 - 1. Level 2 - Heavy Duty, Model 1, full flush design.
- B. Frames:
 - 1. Level 2 for Door Models 1, 16 gage/0.053 inch thick.
- C. Door Core: Cardboard honeycomb. Polystyrene is NOT acceptable.

D. End Closure: Channel, 0.04 inch thick, inverted.

2.3 ACCESSORIES

- A. Silencers: Resilient type.
- B. Removable Stops: Rolled steel channel shape.
- C. Astragals for Double Doors: Steel, Z shaped.
- D. Primer: ANSI A250.10 rust inhibitive type.
- E. Weatherstripping: Specified in Section 08 71 00.

2.4 FABRICATION

- A. Fabricate frames as face welded units.
- B. Fabricate doors and frames with hardware reinforcement welded in place.
- C. Configure exterior frames and doors with profile to receive recessed weatherstripping.

2.5 SHOP FINISHING

- A. Primer: Baked.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION

- A. Install doors and frames in accordance with ANSI A250.8.
- B. Install roll formed steel reinforcement channels between two abutting frames.
- C. Adjust door for smooth and balanced door movement.
- D. Tolerances:
 - 1. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

END OF SECTION

SECTION 08 11 25

INTERIOR FRAMES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Steel frames for doors and windows, with prefinished aluminum cap/trim; non-rated.

1.2 SUBMITTALS

- A. Shop Drawings: Required.
- B. Product Data: Required.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver frames packaged to provide protection during transit and storage at project site.
- B. Store frames at project site under cover and as near as possible to final installation location. Do not use covering material that will cause discoloration of aluminum finish.

1.4 WARRANTY

- A. Frames: Two year warranty.

PART 2 PRODUCTS

2.1 INTERIOR ALUMINUM FRAMES

- A. Manufacturers:
 - 1. Timely
 - 2. Substitutions: Permitted.

2.2 FRAMES

- A. Interior Frames: Throat size to fit wall opening; 2" profile with flush snap-on aluminum cap/trim. These are NOT storefront frames. Provide fire rated frames where noted on Drawings, or as otherwise required by code.
- B. Aluminum: ASTM B221; controlled alloy billets of 6063T5, to assure compliance with tight dimensional tolerances and maintain color uniformity. Extruded aluminum thickness of 0.062 in.

2.3 FABRICATION

- A. Pre-machine jambs and prepare for hardware, with concealed reinforcement plates, drilled and tapped as required, and fastened within frame.
- B. Coordinate with hardware specified in Section 08 71 00.

- C. Provide vinyl or mohair mute.
- D. Provide corner alignment clips for precise butt or mitered connections.
- E. Fabricate all components to allow secure installation without exposed fasteners.

2.4 FACTORY FINISHING

- A. Factory Finish extruded frame so that any part exposed to view upon completion of installation to be uniform in finish and color.
- B. Clear Anodic Coating: AAMA 611, AAM12C22A21 clear anodized coating, 0.4 mil minimum thickness.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine project conditions and verify that the work of this section may properly commence. Beginning of installation constitutes acceptance of conditions.

3.2 INSTALLATION

- A. Install units in accordance with manufacturer's installation instructions. Install plumb and square, securely anchored to substrates with fasteners recommended by manufacturer.
- B. Secure concealed installation clips to main structural extrusion, not to snap-in or trim members.
- C. Do not use screws or other fasteners that will be exposed to view when installation is complete.
- D. Coordinate installation of hardware specified in Section 08 71 00.

3.3 CLEANING

- A. Clean frames after installation, using cleaning methods recommended by frame manufacturer.
- B. Touch up marred areas so that touch-up is not visible. Remove and replace frames that cannot be satisfactorily adjusted.
- C. Provide protection to assure that frames will be without damage or deterioration upon Substantial Completion.

END OF SECTION

SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flush wood doors; flush and flush glazed configuration; non-rated; factory finished.

1.2 SUBMITTALS

- A. Shop Drawings: Required.
- B. Product Data: Required.
- C. Samples: Required.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with NWWDA I.S.1.

1.4 WARRANTY

- A. Furnish manufacturer's "Life of Installation" warranty for interior doors.

PART 2 PRODUCTS

2.1 FLUSH WOOD DOORS

- A. Manufacturers:
 - 1. Algoma Hardwoods Inc.
 - 2. Eggers Industries.
 - 3. Marshfield Door Systems.
 - 4. Mohawk Flush Doors, Inc..
 - 5. Graham.
 - 6. Substitutions: Permitted.
- B. Flush Interior Doors: 1-3/4 inches thick; solid core, five ply construction.

2.2 COMPONENTS

- A. Solid Core, Non-Rated: AWI Section 1300, Type PC - Particleboard.
- B. Veneer Facing: AWI Premium quality wood, plain sliced, with book matched grain, for transparent finish.
 - 1. Wood: Walnut.
 - 2. Finish: Masonite, Cocoa Bean, or approved equal.
- C. Facing Adhesive: Type I - waterproof.

2.3 ACCESSORIES

- A. Glazing Stops: Wood to match veneer.

2.4 FABRICATION

- A. Fabricate doors in accordance with AWI Quality Standards requirements.
- B. Furnish lock blocks at lock edge and top of door for closer for hardware reinforcement.
- C. Factory machine doors for finish hardware.

2.5 SHOP FINISHING

- A. Finish work in accordance with AWI - Section 1500 Factory Finishing; Premium Quality; Stained Transparent.
- B. Seal door top edge with sealer to match door facing.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install doors in accordance with AWI Quality Standards requirements.
- B. Adjust door for smooth and balanced door movement.
- C. Tolerances: Conform to NWWDA requirements for fit and clearance tolerances and maximum diagonal distortion.

END OF SECTION

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aluminum-framed storefronts.
 - 2. Aluminum and glass doors and frames and hardware.
 - 3. Glass.
- B. Related Sections:
 - 1. Section 08 44 13 - Glazed Curtain Wall System

1.2 PERFORMANCE REQUIREMENTS

- A. System Design: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall, including building corners.
- B. Performance Requirements:
 - 1. Air Infiltration: Air leakage through fixed light areas of storefront shall not exceed 0.06 cfm per sq. ft. of surface area when tested in accordance with ASTM E283 at differential static pressure of 6.24 psf.
 - 2. Water Infiltration: No uncontrolled water penetration when tested in accordance with ASTM E331 at test pressure of 10.0 psf.

1.3 SUBMITTALS

- A. Shop Drawings: Required.
- B. Submit type of sealant, if performing sealant work under this section, and color chips for selection.

1.4 WARRANTY

- A. Furnish five year manufacturer warranty for glazed units.
- B. Furnish 10 year warranty for finish.
- C. Provide manufacturer's standard lifetime warranty for entry doors.
- D. Submit a warranty signed by the manufacturer, contractor, installer, agreeing to replace aluminum doors, windows, framing and glazing which fall in materials and workmanship within 2 years of the date of acceptance. Failure of materials or workmanship shall include, but not be limited to, failure in operation of doors, windows, and hardware, excessive leakage of air infiltration, excessive deflections, delamination of panels, deterioration of finish or metal in excess of normal weathering, and defect in accessories, weatherstripping, and other components of the work.

PART 2 PRODUCTS

2.1 ALUMINUM-FRAMED STOREFRONTS

- A. Manufacturers:
 - 1. Tubelite
 - 2. YKK AP America.
 - 3. Substitutions: Permitted.
- B. Product Description:
 - 1. Aluminum Frame: Thermally broken. Frames for interior glazing need not to be thermally broken.
 - 2. Doors: Medium stile; nominal 10 inch high bottom rail.
 - 3. Subsill: Manufacturer's standard High-Performance (HP) subsill.

2.2 COMPONENTS

- A. Extruded Aluminum: ASTM B221.
- B. Sheet Aluminum: ASTM B209.
- C. Sheet Steel: ASTM A653/A653M; galvanized to minimum G90.
- D. Steel Sections: ASTM A36/A36M; shaped to suit mullion sections, galvanized.
- E. Glass: Specified in Section 08 80 00.
- F. Hardware: Refer to Section 08 71 00.
- F. Perimeter Sealant: Specified in Section 07 90 00.

2.3 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Arrange fasteners and attachments to conceal from view.
- E. Prepare components with internal reinforcement for door hardware.
- F. Reinforce framing members for imposed loads.

2.4 SHOP FINISHING

- A. Anodized Aluminum Surfaces: AAMA 611, Class I 0.7 mils clear anodized coating.

- B. Apply bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar metals.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install wall system in accordance with AAMA MCWM-1 - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.
- B. Install sill flashings. Turn up ends and edges to form water tight dam.
- C. Install and adjust door hardware as required to meet the Americans With Disabilities Act (ADA).

3.1 PROTECTION AND CLEANING

- A. Protection: After erection, adequately protect by masking, light motor oil, or other acceptable covering all exposed parts of the work and the finish from damage by grinding and polishing machines and/or by plaster, lime, cement, acid or other harmful substances.
- B. Cleaning: After completion of all other work in the vicinity of the aluminum doors, windows, and framing, remove all masking, or other covering used to protect the work, and thoroughly clean the aluminum surfaces with soap and plain water or a petroleum product such as white gasoline, kerosene, or distillate. Do not use abrasive cleaning agents.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes the supply and installation of the Finish Hardware.
 - 1. Include the termination of all Electrified Hardware.
 - 2. Include field verification of any existing doors, frames or hardware.

- B. Related Sections
 - 1. Division 1
 - 2. Sealants – Division 7
 - 3. Openings – Division 8
 - 4. Finishes – Division 9
 - 5. Fire Alarm –Division 28
 - 6. Electrical –Division 26
 - 7. Security –Division 28

1.02 REFERENCES

- A. Documents and Institutes that shall be used in estimating, detailing and installing the items specified.
 - 1. International Building Code – Current/Adopted Edition
 - 2. ICC/ANSI A117.1 – Accessible and Usable Building and Facilities -Current/Adopted Edition
 - 3. NFPA 70 – Current/Adopted Edition
 - 4. NFPA80 –Standards for Fire Doors and Fire Windows – Current/Adopted Edition
 - 5. NFPA101 – Life Safety Code – Current/Adopted Edition
 - 6. NFPA105 – Installation of Smoke-Control Door Assemblies – Current/Adopted Edition.
 - 7. ANSI - American National Standards Institute
 - 8. BHMA – Builders Hardware Manufacturers Association
 - 9. UL – Underwriters Laboratory
 - 10. DHI – Door and Hardware Institute
 - 11. Accessibility Standards – Current Adopted Edition
 - 12. Local Building Codes

1.03 SUBMITTALS

- A. Comply with pertinent provisions of Division 01.

- B. Finish Hardware Schedule to be in vertical format to include:
 - 1. Heading #/Hardware Set
 - 2. Door #, Location, Hand, Degree of Opening, Door Size and Type, Frame Size and Type, Fire Rating
 - 3. Quantity, type, style, function, product, product number, size, fasteners, finish and manufacturer of each hardware item.
 - 4. Location of hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.

5. Keying schedule
 6. Title Sheet, Index, Abbreviations, Manufacturers List, Template List and Templates.
 7. Mounting locations for hardware.
 8. Explanation of abbreviations, symbols, and codes contained in schedule.
 9. Date of the Finish Hardware Specification and Drawing / Door Schedule used in completing the Finish Hardware Schedule.
 10. In Name, Company and Date of Field Verification if required.
 11. Door Index; include door number, heading number, and hardware group.
 12. Name and phone number for local manufacturer's representative for each product.
 13. Submit in conjunction with Door and Frame Submittal.
 14. Operation Description of openings with electrified hardware.
- C. Product Data: Provide product data in the form of a binder, manufacturer's technical product fact sheets for each item of hardware. Include whatever information may be necessary to show compliance with requirements, including instructions for installation and for maintenance of operating parts and finish.
- D. Wiring Diagrams: Provide Riser/Elevation and Point to Point Wiring Diagrams for all openings with electrified hardware. Include all information that is necessary for coordination with other trades.
- E. Samples: Provide samples as requested by Owner or Architect with Heading # and Door# marked on boxes. All samples will be returned to the contractor and used on doors for which they were marked.
- F. Templates: Provide templates of finish hardware items to each fabricator of doors, frames and other work to be factory or shop prepared for the installation of hardware.
- G. Keying Schedule: After meeting with the Owner, a keying schedule shall be submitted using keyset symbols referenced in DHI manual "Keying Systems and Nomenclature." The keying schedule shall be indexed by door number, keyset, hardware heading number, cross keying instructions and special key stamping instructions.
- H. Operations and Maintenance Data: At the completion of the job, provide to the Owner one hard copies or one electronic copy of an Owner's operation and maintenance manual. The manual shall consist of a labeled hardcover three ring binder with the following technical information:
1. Title page containing: Project name, address and phone numbers. Supplier's name, address and phone numbers.
 2. Table of Contents.
 3. Copy of final (file and field use/as-installed) Finish Hardware Schedule.
 4. Final Keying Schedule.
 5. Maintenance instruction, adjustment, and preservation of finishes for each item of hardware.
 6. Catalog pages for each items of hardware.
 7. Installation Instructions for each item of hardware
 8. Parts List for each item of hardware.
 9. As installed point to point wiring diagrams for electrified hardware.
 10. Warranties include Order #.

1.04 QUALITY ASSURANCES

- A. Substitutions: Request for substitutions shall not be accepted within this project. Architect, Owner and Finish Hardware Consultant have selected one (1) specified and two (2) equals listed hereinafter in the Hardware Schedule. By this selection process they have established three (3) equal products for competitive pricing, while insuring no unnecessary delays by a substitution process. If any specified product is listed as a “No Substitution” product, this product will be supplied as specified, with no alteration or request of substitution. The reason for this is to comply with the uniformity established at this project. Parts and supplies are inventoried for these products for ease and standardization of replacement.
- B. Supplier Qualifications: Supplier shall be recognized architectural finish hardware supplier, with warehousing facilities, who have been furnishing hardware in the project vicinity for a period of not less than 2 year and who is or employs a DHI Certified AHC, DHC, DHSC or person with a minimum of 10 years of experience as a hardware supplier. This person shall be available at reasonable times during the work for consultation about products hardware requirements, to the Owner, Architect and General Contractor.
- C. Installer Qualifications (Mechanical Hardware): All finish hardware shall be installed by the Finish Hardware Installer with a minimum of at least two (2) years documented experience. Installer shall attend a pre-installation meeting between the General Contractor, Finish Hardware Supplier/s, hardware manufacturer’s representative for locks, closers and exit devices, and all door / frame suppliers. The Finish Hardware Installer shall be responsible for the proper installation and function of all doors and hardware.
- D. Installer Qualifications (Electrified Hardware): All electrified finish hardware (power source, electrified locking or control device, switching device, through wire device and monitoring device) shall be installed by an Electronic Access Control Installer licensed by the Texas Department of Public Safety. The Electrified Finish Hardware Installer shall have a minimum of at least two (2) years of documented experience. Installer shall attend a pre-installation meeting between the General Contractor, Finish Hardware Supplier/s, Electrical Contractor, Fire Alarm Contractor, Security Contractor, hardware manufacturer’s representative for electrified hardware, all door / frame suppliers. The Electrified Finish Hardware Installer shall be responsible for the proper installation, termination and function of all opening with electrified hardware. Installation shall include termination of all electrified products (including the required wire to the power supply and/or junction box).

1.05 DELIVERY, STORAGE AND HANDLING

- A. Marking and Packaging: Mark each item or package separately, with identification related to hardware set number, door number and keyset symbol.
- B. Delivery:
 - 1. Deliver individually packaged and properly marked finish hardware at the proper time and location to avoid any delays in construction or installation.
 - 2. At time of delivery, inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.
- C. Storage: Store hardware in enclosed, dry and locked area.

1.06 WARRANTY

- A. All finish hardware products shall be covered by a 1 year factory warranty from the date of substantial completion of the project.
- B. Supply warranty verification to the owner for all products that provide factory warranty. Warranty should include Factory Order # and date.

1.07 MAINTENANCE/EXTRA MATERIALS

- A. Extra Materials:
 - 1. All extra screws, fasteners, and all special installation tools furnished with the hardware shall be turned over to the owner at the completion of the job.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Screws and Fasteners:
 - 1. Coordinate with door supplier and manufacturer to ensure proper blocking and reinforcement is provided to support wood or machine screws when mounting panic hardware and door closers. If proper blocking and reinforcement is not included provide through bolts sized to the thickness of the door. All fasteners should be the proper type and length for the product being supplied.
 - 2. All finish hardware shall be installed to manufacturer's recommendations, using screws, attachments and installation tools provided with the hardware. No other screws or attachments are acceptable.
 - 3. All other products to meet door and frame conditions.
- B. Hinges:
 - 1. Template: Provide templated units only.
 - 2. Exterior: All exterior hinges shall be stainless steel base with stainless steel pin and stainless steel finish.
 - 3. Interior: All interior hinges steel based.
 - 4. Interior corrosive: All interior hinges at corrosive areas shall be stainless steel base with stainless still pin and stainless steel finish.
 - 5. All hinges on doors over 36" wide, with exit devices, or with push/pull shall be heavy weight.
 - 6. Electric Hinge: Provide minimum 8 wire.
 - 7. Provide non-removable pins for out swinging doors that are locked or are lockable.
 - 8. All hinges on doors with door closers shall be ball bearing.
 - 9. All hinges shall be full mortise.
 - 10. Size: Provide 4 ½ x 4 ½ hinges on doors up to 3'0" in width. Provide 5 x 4 ½ hinges over 3'0" to 4'0" in width. Reference manufacturers catalog for all other sizes.
 - 11. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 90" or less in height and one additional hinge for each 30" of additional height.
 - 12. Adjust hinge width as required for door, frame, trim and wall conditions to allow proper degree of opening.
 - 13. Provide hinges conforming to ANSI/BHMA A156.1.

14. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.
15. Supply from the following list of manufacturers:

Ives	IVE
Hager	HAG
Stanley	STA

C. Continuous Hinges:

1. Continuous hinges to be manufactured of 6063-T6 aluminum.
2. Continuous hinge shall be certified to ANSI 156.26, Grade 1
3. Continuous hinge should be tested an approved UL10C.
4. Electrified – Provide minimum 8 wire with removable panel.
5. Provide hinges 1 inch shorter in length than nominal height of door, unless otherwise noted.
6. Provide reinforcing for doors weighing over 450 pounds and up to 600 pounds.
7. Supply from the following list of manufacturers:

Ives	IVE
Select	SEL
Stanley	STA

D. Mortise Locks:

1. All locks on this project should be manufactured by the same manufacturer.
2. Mortise locksets shall meet ANSI/BHMA A156.13, Series 1000, Grade 1 Operational with all standard trims and conventional mortise cylinders.
3. All mortise locks shall be UL Listed for 3 hour fire door. Review lock for any height restriction.
4. Provide locks with a standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
5. Provide standard ASA strikes unless extended lip strike is necessary for frame/trim or 7/8" lip strike is necessary at pair with overlapping astragal.
6. Provide dust box.
7. Supply from the following list of manufacturers:

Schlage	SCH
Falcon	FAL
Corbin Russwin	C-R
Sargent	SAR

E. Cylindrical Locks:

1. All locks on this project should be manufacturer by the same manufacturer.
2. All locks shall meet the new ANSI/BHMA A156.2, Series 4000, Grade 1.
3. All cylindrical locks shall be UL Listed for 3 hour fire door. Review lock for any height restriction.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with a 1/2 inch (13 mm) latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide standard ASA strikes unless extended lip strike is necessary for frame/trim or 7/8" lip strike is necessary at pair with overlapping astragal.
6. Provide dust box.
7. Lockset shall adjust to fit door thickness from 1 3/4" to 2 1/8".
8. Supply from the following list of manufacturers:

- | | | |
|----|----------------|-----|
| 9. | Schlage | SCH |
| | Falcon | FAL |
| | Corbin Russwin | C-R |
| | Sargent | SAR |

F. Exit Devices:

1. All exit device types on this project should be manufactured by the same manufacturer.
2. Exit devices are to be architectural grade touch bar type. Touchpad to extend one half of door width.
3. Mechanism case to be smooth.
4. Exit devices shall meet ANSI A156.3, Grade 1.
5. All exit devices are UL listed Panic Exit or Fire Exit Hardware.
6. All lever trim to match lock trim in design and finish.
7. Dogging: Non-rated devices are to be provided with dogging. Less dogging where shown in Hardware Sets (some exterior, electrical rooms, electrified) Cylinder dogging as shown in hardware sets.
8. Exit devices are to be supplied and installed with thru-bolts for exterior, hollow metal doors, or as required for application.
9. Provide proper power supply for exit devices as required. Coordinate with Fire Alarm, Electrical and Security Contractor.
10. Push pads shall be metal, no plastic inserts allowed.
11. Exit devices shall have a flush end cap.
12. Exit devices shall be ordered with the correct strike for application.
13. Exit devices shall be order in the proper length to meet door width.
14. Exit devices shall have dead latching.
15. Exit device shall be provided in width/height required based on door size.
16. Install exit devices with fasteners supplied by exit device manufacturer.
17. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits as required.
18. Provide proper concealed vertical rods for wood or hollow metal doors as required.
19. Factory or field drill weep holes for exit devices used in full exterior applications, highly corrosive areas, and where noted in the hardware sets.
20. Supply from the following list of manufacturers:

Von Duprin	VON
Sargent	SAR

G. Flush Bolts:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.
2. Supply from the following list of manufacturers:

Ives	IVE
Trimco	TRI
Rockwood	ROC

H. Pull Plates/Pulls/Push Plate:

1. Pull and Push Plates to meet ANSI 156.6 for .050" thickness.

2. Pull and Push Plate size to 4" x 16".
3. Pull Plate to have 10" center and 1" round on pull plate with concealed fasteners.
4. Provide straight and offset pulls with fasteners as required
5. Provide concealed fasteners for all applications.
6. Prep plate for cylinder/lock as required.
7. Supply from the following list of manufacturers

Ives	IVE
Trimco	TRI
Rockwood	ROC

I. Door Closers:

1. All door closers on this project should be manufactured by the same manufacturer.
2. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
3. Door closers shall be furnished with standard cover. Provide full cover as shown in hardware sets.
4. Size in accordance with the manufacturer's recommendations for door size and condition.
5. Door closers shall be furnished with delayed action, hold-open as listed in the Hardware Sets.
6. Door closers shall be mounted out of the line of sight wherever possible (i.e., room side of corridor doors, etc.) with parallel arm mounting on out swinging doors.
7. All closer installation shall include thru bolts on exterior, hollow metal doors or where required for application.
8. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
9. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
10. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
11. Supply from the following list of manufacturers

LCN	LCN
Falcon	FAL
Corbin Russwin	C-R
Sargent	SAR

J. Door Protection Plates:

1. Protective plates shall meet ANSI A156.6 requirements for .050 thickness.
2. Protection plates should be fabricated from stainless steel.
3. Protection plate shall be height as shown in Hardware Sets. Width shall be 10" by 2" less than door width on single door or pair with a mullion and 1" less than door width on pair of doors without a mullion.
4. Beveled 4 edges.
5. Provide kickplate on all doors with closers, unless not required for aesthetic reasons.
6. Prep protective plates for hardware as required.
7. Supply from the following list of manufacturers:

Ives	IVE
Rockwood	ROC
Trimco	TRI

- K. Door Stops and Holders:
1. Supply wall stops at all openings to protect doors or door hardware. Install so lock does not lock unintentionally. Install blocking in wall where wall stop will be mounted.
 2. When wall conditions do not permit use of wall stop provide floor stops with risers as needed to adjust for floor conditions.
 3. When wall conditions do not permit use of wall stop provide overhead stops. Jamb mount where required to not be visible from Corridor.
 4. Exterior Ground Level Doors: Provide security floor stop.
 5. Exterior Roof Doors: Provide heavy duty overhead stop.
 6. Supply from the following list of manufacturers:

Glynn Johnson	GLY
Rockwood	ROC
Trimco	TRI
- L. Silencers:
1. Provide silencers on all doors without seal. 3 for single doors and 2 for pairs.
 2. Provide silencers as required for frame conditions. SR64 for hollow metal frames. SR65/SR66 for wood frames.
 3. At wood frames, insure height of stop is compatible with silencer.
 4. Supply from the following list of manufacturer's

Ives	IVE
Rockwood	ROC
Trimco	TRI
- M. Thresholds/Weatherstripping:
1. Thresholds on doors in the accessible path shall conform to accessibility codes.
 2. Threshold should be based on sill detail.
 3. Smoke seal shall be teardrop design bulb seal.
 4. Exterior seal/thresholds shall be silicone or brush as shown in hardware sets.
 5. Drip strips shall protrude 2 ½" and be 4" wider than opening.
 6. At S Label single doors provide seals on frame to comply with UL1784
 7. At S Label pair of doors provide seals on frame and as meeting stile to comply with UL1784.
 8. Automatic Door Bottom shall be mortised to comply with accessibility codes.
 9. Supply from the following list of manufacturer's

Zero	ZER
National Guard	NGP
Pemko	PEM

2.03 KEYING

- A.

2.04 KEY CONTROL

- A. Key control shall be provided, by supplying a complete key storage and management system. Provide a complete key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers and standard metal cabinet. Size of system to be 150% of the number of locks required for the project.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine doors, frames and related items for conditions that would prevent the proper application of any finish hardware items. Do not proceed with installation until all defects are corrected.
- B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Follow Door and Hardware Institute Publication:
Recommended Location for Architectural Hardware for Standard Steel Doors and Frames
Recommended Location for Builder's Hardware for Custom Steel Doors and Frames
Recommended Locations for Architectural Hardware for Wood Flush Door
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Follow ANSI A117.1-1998 Accessible and Usable Building and Facilities and Texas Accessibility Standards.
- D. Review mounting locations with Architect where required.
- E. Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers should not be visible in corridors, lobbies and other public spaces where possible.
- F. Locate power supplies in accessible location and indicate in as-builts where located.
- G. Set threshold in full bed of sealant complying with requirements specified in Division 07.
- H. Pre Installation meeting required with attendees to include Architect, General Contractor, Mechanical Hardware Installer, Electrified Hardware Installer, Finish Hardware Supplier and Manufacturer's Representative for Exit Device, Locks and Closers and Door/Frame Suppliers before installation begins.

3.03 FIELD QUALITY CONTROL

- A. After installation has been completed, obtain the services of an Architectural Hardware Consultant to check for proper installation of finish hardware, according to the finish hardware schedule and keying schedule. In addition, check all hardware for adjustments and proper operation.

3.04 ADJUST AND CLEAN

- A. Adjust, clean and inspect all hardware, to ensure proper operation and function of every opening. Replace items, which cannot be adjusted to operate freely and smoothly as intended for the application made.

3.05 PROTECTION

- A. The General Contractor shall use all means at his disposal to protect all finish hardware items from abuse, corrosion and other damage until the owner accepts the project as complete.

3.06 TRAINING

- A. After installation has been completed, provide training to the Owner on the operation of the Finish Hardware and programming of any electrified hardware.

3.07 HARDWARE SCHEDULE

- A. These hardware set shown below are for use as a guideline. Provide hardware as required to meet the requirements of the openings, security, and code requirements.

PROVIDE 1-1/2" EXTENDED LIP STRIKES WHERE ALUMINUM SNAP ON TRIM IS USED.

HARDWARE GROUP NO. 001

FOR USE ON DOOR #(S):

17

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
-ALL HARDWARE BY VAULT DOOR MANUFACTURER.				

HARDWARE GROUP NO. 103

FOR USE ON DOOR #(S):

04 06 07 05

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA ENTRY LOCK	B501P QUA	626	FAL
1	EA WALL STOP	WS406/407CCV	630	IVE

HARDWARE GROUP NO. 105

FOR USE ON DOOR #(S):

03

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	DORMITORY/EXIT LOCK	MA571P QG	626	FAL
1	EA	SURFACE CLOSER	SC71A SS	689	FAL
1	EA	GASKETING	188S H & J	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A LENGTH AS REQ	A	ZER
1	EA	DOOR SCOPE	DS/2000	689	

HARDWARE GROUP NO. 201CH

FOR USE ON DOOR #(S):

12

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	B581P6 QUA	626	FAL
1	EA	SURFACE CLOSER	SC71A SSSH	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

HARDWARE GROUP NO. 261L

FOR USE ON DOOR #(S):

08

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STORE DOOR LOCK	MA371P QG	626	FAL
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS410	626	IVE

HARDWARE GROUP NO. 341C

FOR USE ON DOOR #(S):

10 11

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	MA311 OCCUPIED/VACANT QGM	626	FAL
1	EA	SURFACE CLOSER	SC71A SS	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188S H & J	BK	ZER

HARDWARE GROUP NO. 401H

FOR USE ON DOOR #(S):

15

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	B101S QUA	626	FAL
1	EA	SURFACE CLOSER	SC71A HO	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE

HARDWARE GROUP NO. 501F

FOR USE ON DOOR #(S):

09

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	B561P QUA	626	FAL
1	EA	SURFACE CLOSER	SC71A REG OR PA AS REQ	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS410	626	IVE

HARDWARE GROUP NO. 503S

FOR USE ON DOOR #(S):

14

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	B561P QUA	626	FAL
1	EA	OH STOP	90S	630	GLY

HARDWARE GROUP NO. AC714A

FOR USE ON DOOR #(S):

01 02

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-3547A-EO	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-3547A-NL-OP	626	VON
1	EA	RIM CYLINDER	951	626	FAL
2	EA	90 DEG OFFSET PULL	8190-O 10"	630	IVE
1	EA	SURFACE CLOSER	SC71A SS	689	FAL
1	EA	SURF. AUTO OPERATOR	9542 REG (PUSH)	ANCLR	LCN
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	PS902 900-2RS	LGR	SCE
1	SET	MEETING STILE	BY DOOR MANUFACTURER		
1	SET	PERIMETER SEAL	BY FRAME MANUFACTURER		

-INGRESS BY THE CARD READER, KEY OVERRIDE

-EGRESS BY THE PANIC HARDWARE.

-PROVIDE MOUNTING ACCESSORIES ; COORDINATE WITH DOOR/FRAME SUPPLIER.

-MOUNT OPERATOR ON RHR LEAF AND CLOSER ON LHR LEAF.

-SET PUSH "N" GO FEATURE TO ON. PUSHING OR PULLING DOOR OPEN 5 DEGREES CAUSES OPERATOR TO OPEN REMAINDER OF WAY AND HOLD OPEN TO THE AMOUNT OF HOLD OPEN DELAY SET. (1 TO 32 SECONDS). NO PUSH BUTTONS/ACTUATORS USED.

-THE ELECTRIC LATCH PANIC HARDWARE WILL BE SET TO BE RETRACTED DURING BUSINESS HOURS BY ACCESS CONTROL SYSTEM. AFTER HOURS THE ELECTRIC LATCH PANIC HARDWARE WILL BE LATCHED AND DOORS WILL BE SECURE.

HARDWARE GROUP NO. C201C

FOR USE ON DOOR #(S):

13

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	B581P6 QUA	626	FAL
1	EA	ELECTRIC STRIKE	4211 FSE	630	VON
1	EA	SURFACE CLOSER	SC71A SS	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

HARDWARE GROUP NO. C701AH

FOR USE ON DOOR #(S):

18

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-35A-NL-OP	626	VON
1	EA	RIM CYLINDER	951	626	FAL
1	EA	90 DEG OFFSET PULL	8190-O 10"	630	IVE
1	EA	SURFACE CLOSER	SC71A SSHO	689	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	POWER SUPPLY BY SECURITY CONTRACTOR		
1	SET	PERIMETER SEAL	BY FRAME MANUFACTURER		

-PROVIDE MOUNTING ACCESSORIES FOR CLOSERS; COORDINATE WITH DOOR/FRAME SUPPLIER.

-INGRESS BY THE CARD READER OR KEY OVERRIDE.

-EGRESS BY THE PANIC HARDWARE.

HARDWARE GROUP NO. K201H

FOR USE ON DOOR #(S):

16

PROVIDE EACH DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP-SPA-P6	626	SCE
1	EA	SURFACE CLOSER	SC71A HO	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE

END OF SECTION

SECTION 08 80 00

GLAZING

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass and glazing for metal frames, doors, and windows.
 - 2. Glass and glazing materials and installation requirements are included in this section for other sections referencing this section.

1.2 PERFORMANCE REQUIREMENTS

- A. Glass Thickness: Select minimum thickness in accordance with ASTM E1300 to resist specified design loads.
- B. Structural Design: Design in accordance with applicable code for most critical combination of wind, snow, seismic, and dead loads.
- C. Roof Loads: Design sloped glass to resist live and dead loads.
- D. System Design: Design and size components to withstand dead loads and live loads caused by pressure and negative wind loads acting normal to plane of window.

1.3 SUBMITTALS

- A. Shop Drawings: Required.
- B. Product Data: Required. Submit solar heat gain coefficient, as well as thicknesses and tint for glass.
- C. Samples: Required.

1.4 QUALITY ASSURANCE

- A. Qualifications of Installers: Provide at least one person thoroughly trained and experienced in skills required, completely familiar with referenced standards and requirements of this work and to personally direct installation performed under this Section.
- B. Applicable Standards For Glass and Glazing Work: Conform to the "Manual of Glazing" of the Flat Glass Marketing Association, requirements of Federal Specification DD-G-451c and Safety Standard 16 CFR 1201 of the U.S. Consumer Products Safety Commission.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery:
 - 1. Deliver glass to site in accordance with manufacturer's instructions.
 - 2. Deliver glass in manufacturer's or fabricator's original containers and packaging, with labels clearly identifying product name and manufacturer.

- B. Storage:
 - 1. Store glass in accordance with manufacturer's instructions.
 - 2. Store glass in clean, dry area indoors.
 - 3. Protect from exposure to direct sunlight and freezing temperatures.
 - 4. Apply temporary coverings loosely to allow adequate ventilation.
 - 5. Protect from contact with corrosive chemicals.
 - 6. Avoid placement of glass edge on concrete, metal, and other hard objects.
 - 7. Rest glass on clean, cushioned pads at 1/4-points.

- C. Handling:
 - 1. Handle glass in accordance with manufacturer's instructions.
 - 2. Protect glass from damage during handling and installation.
 - 3. Do not slide 1 lite of glass against another.
 - 4. Do not use sharp objects near unprotected glass.

1.6 WARRANTY

- A. Furnish five year warranty for sealed glass units.

PART 2 PRODUCTS

2.1 GLASS MATERIALS

- A. Annealed Glass: ASTM C1036, Type 1 transparent flat, Quality Q3, float glass.
- B. Heat Strengthened Glass: ASTM C1048, Type 1 transparent flat, Quality Q3, uncoated.
- C. Tempered Glass: ASTM C1048, Type 1 transparent flat, Quality Q3, uncoated.
- D. Mirrors: Polished plate glass, No. 1 silvering quality with electrolytic copper backs; 1/4 inch thick.
- E. Provide safety glazing as required by code. Provide heat strengthened glass where required by design pressures, anticipated thermal stress, or use in spandrel areas. Provide fully tempered glass only where safety glazing is mandatory or where pressures exceed capacity of heat strengthened glass.

2.2 FLOAT GLASS PRODUCTS

- A. Clear Glass: Annealed, Heat strengthened, and Tempered float glass as specified; Class 1 clear.
- B. Tinted Glass: Annealed, Heat strengthened, and tempered float glass as specified; Class 2 tinted.
 - 1. Tint: Grey.
- C. Minimum Thickness: 1/4 inch unless otherwise indicated.

2.3 INSULATING GLASS PRODUCTS

- A. Insulating Glass: ASTM E2190.

1. Total Unit Thickness: 1 inch unless otherwise indicated.
- B. Double Pane Insulating Glass:
1. Product: Solarban 60 (Solargrey + clear) manufactured by Oldcastle.
 2. U-Factor Winter Nighttime: 0.29 maximum.
 3. U factor Summer Daytime: 0.27 maximum.
 4. Solar Heat Gain Coefficient: 0.24 maximum.

2.4 GLAZING ACCESSORIES

- A. Provide glazing accessories required to complete glazing work, that are compatible with various components of the glazing system(s), and subject to approval of Architect.
- B. Glazing Sealants, Gaskets and Tapes: Materials compatible with adjacent materials including glass and glazing channels; type recommended by manufacturer to suit application.
- C. Setting Blocks: Silicone blocks tested for compatibility with specified glazing sealants. Provide side blocks at both jambs, between midheight and top corner of glass, at four-side conventional dry glazed openings. Side blocks are not required where glass is continuously sealed with silicone sealant at two or more edges.
- D. Compressible Filler Rod: Closed-cell or waterproof-jacketed foam of polyethylene, butyl rubber, neoprene, polyurethane or vinyl, tested for compatibility with specified glazing sealants, of 5 to 10 psi compression strength (25% deflection), recommended by sealant manufacturer for use in glazing channel to prevent sealant exudation from the channel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings for glazing are correctly sized, within tolerance, and glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
- B. Notify Architect of conditions that would adversely affect installation. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Seal porous glazing channels or recessed with substrate compatible primer or sealer.
- B. Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION

- A. Perform installation in accordance with GANA Glazing Manual.
1. Glazing Sealants: Comply with ASTM C1193.
- B. Install glass in accordance with manufacturer's instructions.

3.4 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass, mirrors, and adjacent surfaces.
- D. Clean glass on both sides after painting operations are complete and dry. Do not use acid solutions or caustic soaps to clean glass.
- E. Do not use razor blades to clean glass. Any scratches on the glass caused by the cleaning process will be cause for the removal and replacement of the damaged glass at the Contractor's expense.

3.5 PROTECTION

- A. Protect installed glass from damage during construction.
- B. Protect installed glass from contact with contaminating substances resulting from construction operations.
- C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in other ways during construction period, including natural causes, accidents, and vandalism.

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal stud wall framing.
 - 2. Cementitious backer board.
 - 3. Sound partitions.
 - 4. Acoustic insulation.
 - 5. Textured finish.

1.2 SUBMITTALS

- A. Product Data: Required.
- B. Samples: Submit sample of wall texture for approval, before proceeding.

1.3 PROJECT CONDITIONS

- A. In cold weather, heat building to provide uniform temperature of 50 to 70 and provide ventilation to eliminate excess moisture.

1.4 SYSTEM DESCRIPTION

- A. Provide materials and installation at sound partitions noted on Drawings to achieve STC57.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Manufacturers:
 - 1. BPB Americas Inc.
 - 2. G-P Gypsum Corp.
 - 3. National Gypsum Co.
 - 4. United States Gypsum Co.
 - 5. Substitutions: Permitted.
- B. Sound Rated Partitions Components Manufacturer: PABCO or approved equal.

2.2 COMPONENTS

- A. Framing Materials:
 - 1. Furring, Framing, and Accessories: ASTM C645; GA-216; galvanized sheet steel, 20 gage(33 mils) thick unless noted otherwise.

2. Fasteners: ASTM C1002; Type S, GA-216.
 3. Adhesive: ASTM C557, GA-216.
- B. Gypsum Board Materials: ASTM C1396.
1. Standard Gypsum Board: 5/8 inch thick.
 2. Moisture Resistant Gypsum Board: 5/8 inch thick.
 3. Sound Deadening Gypsum Board: ASTM C208-12; Quiet Rock or approved equal.
 - a. Size: 5/8" thick; fire resistant where noted on Drawings.
 - b. STC: 57 when measured in accordance with ASTM E90.
- C. Tile Backer Board:
1. Cementitious Backing Board: High density, glass fiber reinforced, ½ inch thick.

2.3 ACCESSORIES

- A. Acoustic Insulation: ASTM C553 and C665; preformed glass fiber, unfaced.
- B. Acoustic Sealant: Quiet Seal Pro.
- C. Acoustic Putty: Quiet Putty.
- D. Casing Bead: "Goldbond" No.500 galvanized steel by National Gypsum Co., or approved equal. Furnish and install metal reveal strips where shown and detailed.
- E. Corner Beads: 0.014 inch thick, hot dip galvanized steel with 1" flanges with 1/16" radius nose with large openings in flange similar to 5/8" diameter holes 7/8" on center.
- F. Control and Expansion Joints: "Sheetrock" zinc control joint No.093 by USG, or approved equal. Provide safing and/or acoustical insulation behind control joints as required for adjacent partition construction. Use fire rated control joints in partitions requiring a fire rating.
- G. Joint Materials: ASTM C475; GA-216; reinforcing tape, joint compound, adhesive, and water.
- H. Drywall Screws: Self-drilling type, 1" long for single layer application of gypsum board to metal studs and furring channels and of longer length for multiple layer installation.

PART 3 EXECUTION

3.1 GENERAL

- A. Comply with specified requirements, manufacturer's instructions and recommendations, and referenced standards.
- B. Deliver materials to job in original unopened containers or bundles and store protected from damage and exposure to the elements.
- C. Cooperate with carpenters in placing of backing and blocking required for millwork, fixtures, fittings, and accessories.

- D. Make cut-outs in panels for pipes, fixtures and small openings. Make holes and cut-outs by method that will not fracture wallboard core or tear covering. Cut holes with accuracy so plates, escutcheons and trim cover edges.
- E. At any change in direction of gypsum board, provide sufficient auxiliary framing, blocking or nailers to allow secure attachment along every edge of every individual piece of gypsum board. Do not leave any loose edges.

3.2 INSTALLATION – FRAMING

- A. Metal Studs:
 - 1. Install studs in accordance with ASTM C754 and GA-216.
 - 2. Metal Stud Spacing: 16 inches o.c.
 - 3. Partition Heights: Full height to structure above unless noted otherwise. Install additional bracing for partitions extending above ceiling.
 - 4. Install bead of Quiet Seal Pro between studs and floor, walls and ceiling, at sound partitions.

3.3 INSTALLATION - GYPSUM BOARD

- A. Install sound attenuation blankets where indicated, prior to gypsum board unless readily installed after board has been installed. Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions. Install acoustic sealant within partitions.
- B. Install gypsum board in accordance with GA-216.
- C. Fasten gypsum board to furring or framing with screws. Staples may only be used when securing first layer of double layer applications.
- D. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 1'-0" in alternate course of board.
- E. Install ceiling boards in the direction and manner which will minimize the number of end-butt joints, and which will avoid end joints in the central area of each ceiling. Stagger end joints at least 1'-0".
- F. Install Quiet Putty at electrical penetrations and outlets.
- G. Install gyp. bd. and Quiet Rock in accordance with Quiet Rock installation details, to meet STC rating at sound partitions. Refer to drawings for locations.
- H. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16 inch open space between boards. Do not force into place.
- I. Locate either edge or end joints over supports, except in horizontal applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges and mill-cut or field-cut ends against mill-cut or field cut ends. Do not place tapered edges against

cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.

- J. Attach gypsum board to framing and blocking as required for additional support at openings and cutouts. Space between recessed boxes and cut edges shall not exceed 1/8 inches.
- K. Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories described below .
- L. Cover both faces of partition framing with gypsum board in concealed spaces (above ceilings, etc.) except in chase wall which are braced internally.
- M. Space fasteners in gypsum boards in accordance with referenced standards and manufacturer's recommendations, except as otherwise indicated.
- N. Lightly roll texture. Heavy textures are not allowed.
- O. Seal cut edges, holes, and areas where wallboard covering is broken, with water resistant sealer.

3.4 INSTALLATION - DRYWALL TRIM ACCESSORIES

- A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges to comply with manufacturer's recommendations.
- B. Install trim in strict accordance with manufacturers' recommendations. Install trim plumb, level, and true to line with firm attachment to supporting members.
- C. Install metal corner beads at external corners of drywall work. Corner beads are to be completely bedded and taped.
- D. Provide casing beads where edges of gypsum board meet dissimilar materials.
- E. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where semi-finishing type is indicated. Install L-type trim where work is tightly abutted to other work, and install special kerf-type where other work is kerfed to receive long leg of L-type trim. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).
- F. Install metal control joints where indicated on drawings. If not indicated on drawings, install in accordance with the following:
 - 1. Interior Partitions: Maximum Single Dimension not to exceed 20 feet. Maximum Single Area not to exceed 400 sq. ft.

3.5 JOINT TREATMENT AND FINISHING

- A. All joints in gypsum board construction are to be taped and floated. This includes work above ceilings, at concealed places and anywhere else joints in gypsum board construction occur.
 - 1. All screw and/or nail heads are to be floated smooth both above and below ceiling line.

B. Finish Levels:

- 1. Level 1: At Ceiling plenum areas and concealed areas.
- 2. Level 2: At surfaces that are substrate for tile.
- 3. Level 4 (typical Finish): At surfaces receiving light (Semi-Smooth) finishes before painting or standard wall coverings or satin/eggshell paint or flat paint.
- 4. Level 5: At surfaces receiving gloss or semigloss enamels and/or other surfaces subject to severe lighting.

3.6 TOLERANCES

- A. Tolerances: Maximum Variation from Flat Surface: 1/8 inch in 10 feet in any direction.

3.7 CLEANING UP

- A. Do not allow accumulation of scraps and debris arising from work of this Section. Maintain premises in neat and orderly condition at all times. Immediately remove spilled or splashed compound material and all trace of residue from adjoining surfaces.

END OF SECTION

SECTION 09 30 00

TILING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Porcelain tile for floor applications.
 - 2. Porcelain tile for wall application.
 - 3. Crack suppression membrane.
 - 4. Thin-set application methods.
 - 5. Accessories.

1.2 SUBMITTALS

- A. Product Data: Required.

1.3 QUALITY ASSURANCE

- A. Tile must be from the same die lot and caliber.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years' experience.
- C. Source Limitations for Setting Materials and Accessories: Obtain product of a uniform quality for each application condition from a single manufacturer.
- D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.
- E. Preinstallation Conference: Conduct conference at the Project site.
 - 1. Convene one week prior to commencing work of this section.
 - 2. Require attendance of installation material manufacturer, tile supplier, tile installer and installers of related work. Review installation procedures and coordination required with related work.
 - 3. Meeting agenda includes but is not limited to:
 - a. Surface preparation.
 - b. Tile and installation material compatibility.
 - c. Manufacturer and installer warranty duration and scope covered by warranty.
 - d. Edge protection, transition, and pre-fabricated movement joint profiles.
 - e. Waterproofing techniques.
 - f. Crack isolation techniques

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
- C. Store materials in a dry, warm, ventilated weathertight location.

1.5 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.

1.6 WARRANTY

- A. Provide sample warranty during submittal process.
- B. Acknowledge warranty duration + scope covered by warranty.
- C. Coordinate Work with other operations and installation of floor finish materials to avoid damage to installed materials.
- D. Obtain products of a uniform quality for each premanufactured tile profile, and mortar and waterproofing and uncoupling membrane from a single manufacturer, to maintain the installation system and provide multi-product warranty from selected manufacturer.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Required.

1.8 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Supply 10 sq ft of each size, color, and surface finish of tile specified.

PART 2 PRODUCTS

2.1 TILE PRODUCTS

- A. T1 and T2 - Porcelain Floor Tile:
 - 1. Manufacturer: IRIS
 - 2. Style: Travertini Al Contro
 - 3. Colors: Grigio
 - 4. Size: 12 x 24
- B. T3 – Porcelain Wall Tile:
 - 1. Manufacturer: IRIS
 - 2. Style: Travertini Al Contro

3. Color: Bianco
4. Size: 12 x 24 and 3 x 12
5. Finish: Matte

2.2 ACCESSORIES

- A. Cementitious Backer Board: Refer to Section 09 21 16.
- B. Uncoupling Membrane: Schluter, Ditra .
- C. Self-levelling Underlayment: Custom, LevelQuik, or approved equal.
- D. Leveling System: Raimondi leveling clips or approved equal.
- E. Schluter-ALL SET Modified Thin Set Mortar: Specialized sag-resistant modified thin-set mortar specifically formulated for use with Schluter membranes and boards. Engineered for use both under and over DITRA and KERDI products. Suitable for use with ceramic, porcelain, and stone tile, including large and heavy tile, in conjunction with Schluter-Systems' uncoupling and waterproofing membranes. Meets the requirements of ANSI A118.4T, A118.11, and A118.15T.
 1. Color: White.
- F. Grout Materials: Stain proof, single component such as Custom, Fusion Pro, or approved equal.
 1. Colors: As selected.
- H. Soft Joint Sealant: 100% silicone such as Commercial Silicone by Custom, or approved equal.
- I. Tile Floor Edging:
 1. Tile to Carpet: Schluter, Schiene
 - a. Profile Height: As required to coordinate with tile selection and setting system.
 - b. Material and Finish: Satin Anodized Aluminum.
 2. Tile to LVT: Schluter Reno-U.
 - a. Profile Height: As required to coordinate with tile selection and setting system.
 - b. Material and Finish: Satin Anodized Aluminum.
- J. Corner Movement Joint: Schluter, DILEX – EKE; Profile with integrated rigid, recycled PVC trapezoid-perforated anchoring legs, connected at a 90-degree angle by a 3/16 inch (5 mm) wide soft CPE movement zone that forms the visible surface.
 1. Profile Height: As required to coordinate with tile selection and setting system.
 2. Movement Zone Color: As selected by Architect.

PART 3 EXECUTION

3.1 PREPARATION

- A. Do not begin installation until substrates have been properly prepared. Beginning of installation constitutes acceptance of substrate.

- B. Install underlayment to achieve floor flatness as required by tile manufacturer for large format tile.
- C. Install uncoupling membrane over entire floor area.

3.2 INSTALLATION

- A. Install tile, transitions, and grout in accordance with applicable requirements of ANSI A108.1, A108.10, and TCA Handbook recommendations. Use leveling clips to achieve 3/32" grout joints.
- B. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly.
- C. Grout tile joints.
- D. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.
- E. Apply silicone sealant at soft joints as recommended by the TCNA.

3.3 PROTECTION

- A. Do not install walls or other building components on tile until grout has cured a minimum of 30 days.

END OF SECTION

SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Suspended metal grid ceiling system and perimeter trim.
 - 2. Acoustic panels.

1.2 PERFORMANCE REQUIREMENTS

- A. Design and install suspended ceilings in accordance with requirements listed in the 2012 edition of the IBC and ASTM E580, for seismic category E.
- B. Splice Connection Strength of Main Beams, Cross Tee Intersections and Splices: 180 pounds compression and tension.
- C. Cross tees supporting light fixtures must have the same load-carrying capacity as the main beams, or be fitted with supplemental hangers.
- D. Hanger wire attachment devices: Capable of supporting minimum 100 pounds.

1.3 SUBMITTALS

- A. Product Data: Required.
- B. Samples: Submit pattern and finish samples for stamped ceiling, for selection by Architect.

1.4 QUALITY ASSURANCE

- A. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40% during and after acoustic unit installation.

1.6 WARRANTY

- A. Acoustical Panels: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:
 - 1. Acoustical Panels: Sagging and warping as a result of defects in materials or factory workmanship.
 - 2. Grid System: Rusting and manufacturer's defects.

3. Acoustical Panels with BioBlock Plus or designated as inherently resistive to the growth of micro-organisms installed with Armstrong suspension systems: Visible sag and will resist the growth of mold/mildew and gram positive and gram negative odor and stain causing bacteria.
- B. Warranty Period - Humiguard:
1. Acoustical panels: Ten (10) years from date of substantial completion.
 2. Grid: Ten (10) years from date of substantial completion.
 3. Acoustical panels and grid systems with HumiGuard Plus or HumiGuard Max performance supplied by one source manufacturer is thirty (30) years from date of substantial completion.
- C. Warranty – Stamped Ceiling: Provide manufacturer’s standard 10 year written warranty against defective workmanship and materials.

1.7 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout: Spare parts and maintenance products.
- B. Furnish 40 sq ft of each type of extra panel to Owner.

PART 2 PRODUCTS

2.1 CEILING PANEL COMPONENTS

- A. Acoustic Panels: ASTM E1264.
1. Manufacturer/Style: Armstrong, Dune or approved equal.
 2. Size: 24 x 24 inches.
 3. Thickness: 5/8 inches.
 4. Edge: Tegular.

2.2 SUSPENSION SYSEM COMPONENTS

- A. Suspension System – Acoustic Panels:
1. Non-fire Rated Grid: ASTM C635, intermediate duty; exposed T, tegular configuration.
 2. Grid Materials: Cold rolled steel with galvanized coating.
 3. Exposed Grid Surface Width: 15/16 inch with reveal.
 4. Grid Finish: White.
- B. Accessories:
1. Support Channels and Hangers: Galvanized steel, minimum 12 gage.
 2. Provide seismic joint clip per ASTM A568 or BERC2 clip.
 3. Provide hold down clips at restrooms and within 20 ft. of an exterior door.

PART 3 EXECUTION

3.1 INSTALLATION

A. Suspension System:

1. Install suspension system in accordance with ASTM C636 and ASTM E580, and special requirements for seismic category E.
2. Coordinate location of hangers with other work. Where components prevent regular spacing of hangers, reinforce system to span extra distance. Suspension wires to have maximum 4' spacing.
3. Locate system on room axis according to reflected plan. Hang system independent of wall molding, ducts, pipes and conduit.
4. Provide minimum 3/8" clearance on all sides with minimum 3/8" overlap of suspension system on wall molding.
5. Do not attach suspension system to wall molding.
6. Tie ends of main beams and cross tees together to prevent spreading.
7. Provide safety wires on light fixtures.

B. Acoustic Units:

1. Fit acoustic units in place.
2. Install hold-down clips to retain regular ceiling panels tight to grid system within 20 ft. of exterior door and at restrooms.

END OF SECTION

SECTION 09 54 23

LINEAR SUSPENDED POLYMER CEILINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes: Suspension carrier system, polymer ceiling strips, and associated accessories to provide complete Endure Linear suspended ceiling system.

1.2 REFERENCES

- A. ASTM E84 – Surface Burning Characteristics of Building Materials; 2001.
- B. ASTM E330 – Uniform Static Air Pressure Difference – Wind Load
- C. ASTM C636 – Standard Practice for Installation of Metal Ceiling Suspension Systems
- D. ASCE 7-10; ASTM E580 – Seismic Design Category E.

1.3 DESIGN / PERFORMANCE REQUIREMENTS

- A. Suspension System: Rigidly secure suspended ceiling system including integral mechanical and electrical components with maximum deflection of 1/360. Reference ASTM C636.
- B. Engineered polymer strips will undergo changes with variations in the environment. Therefore, all dimensional tolerances are plus or minus 1/8 inch (3 mm).
- C. Seismic suspended engineered polymer ceilings meet seismic code compliance via direct mechanical attachment to structural carriers. Provide bracing as required and installation to meet seismic category E.
- D. Fire Performance Characteristics: Suspended ceilings shall conform to Class 1, or A flame spread rating, tested according to ASTM E84; Flame Spread: 25 or less. Smoke Developed: 450 or less.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data & Warranty: Manufacturer's data sheets and supplementary information on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Removal and replacement for plenum access for maintenance and operations
- C. Shop Drawings: Provide layout of polymer ceiling and carrier system coordinated with other trades to mitigate interference. Recessed or surface mounted devices located within the ceiling panels shall also be coordinated and independently suspended per ASTM C636. Indicate method of suspension or attachment where interference exists.

- D. Verification Samples: For each finish specified, one (1) sample, 12" (305mm) wide x 12" (305mm) long shall be submitted for approval representing actual product, color, and patterns.
- E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- F. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking and adjustment and periodic cleaning and maintenance of all components.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Minimum 2 years documented experience installing projects of similar size and complexity.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in the manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store products off the floor in manufacturer's unopened packaging protected from exposure to harmful environmental conditions and at temperature and humidity conditions as recommended by the manufacturer.
- C. A minimum of 12 hours prior to ceiling installation, engineered polymer ceilings shall be stored in the area in which they will be installed. Temperature and humidity of the area during this period shall closely approximate those conditions that will exist when the building is occupied.
- D. Handle materials carefully to avoid damage.

1.7 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 WARRANTY

- A. Manufacturer: All materials supplied by the ceiling manufacturer shall be guaranteed against manufacturing defects for one (1) year. Due to differing site conditions, finishes can vary with age and are excluded from this warranty.

1.9 COORDINATION

- A. Coordinate layout and installation of the engineered polymer ceilings with other work penetrating the ceiling including light fixtures, HVAC equipment, and fire suppression system components. Refer to manufacturer's hosted submittal site for typical details.

1.10 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements.

- B. Deliver materials for Owner's use in maintenance.
 - 1. Provide 5-10 percent of each type installed for use by owner in building maintenance and repair.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Rulon International, 2000 Ring Way Rd.; St Augustine, FL 32092; Tel: 800-227-8566; Tel: 904-584-1400; Fax: 904-584-1499; Email: nationalaccounts@rulonco.com; Web: rulonco.com
- B. Substitutions: In accordance with Section 01 60 00.

2.2 MATERIALS - GENERAL

- A. Engineered polymer will expand or contract slightly with temperature changes and therefore all dimensional tolerances are plus or minus 1/8 inch (3 mm).

2.3 ENDURE LINEAR ENGINEERED POLYMER SUSPENDED CEILING SYSTEM

- A. Engineered polymer ceiling strips are made with an engineered polymer core and can be furnished in solid colors or with a woodgrain or metallic film applied to the face. Engineered polymer strips are nearly inert to harsh, moist weather conditions. Strips are completely recyclable and UV resistant.
 - 1. 900 Series Engineered Polymer Strips:
 - a. Ceiling pans are provided with integral spacers between the edges of each strip, with the flat face visible.
 - b. Ceiling pans are 3-1/4 inches (83 mm) wide with an integral 3/4 inch (19 mm) spacer and placed into a design module of 4 inches (102 mm) with square sides.
 - 2. Trim and Border Treatment: Provide perimeter trim and expansion joints as needed.
 - 3. Finish:
 - a. As selected by the Architect or Interior Designer from the manufacturer's standard selections.

2.4 ACCESSORIES

- A. System Carriers: Only use system carriers that are supplied by the same manufacturer supplying the engineered polymer ceiling system to ensure compatibility. Carriers may be suspended or direct-screwed.
- B. Matching Trim: Only use matching trim supplied by the same manufacturer of the engineered polymer system to ensure compatibility in fit and color.
- C. Access Hatches: Refer to detail on Drawings.

2.5 SUSPENSION SYSTEMS

- A. System Carriers: Endure Powder Coated Galvanized Carriers, installed 6 inches from perimeter and maximum 2 feet on center.
 - 1. Suspend via hanger wire in accordance with ASTM C636 or directly attach carriers to structure or framing.

2.6 FABRICATION

- A. Edges, borders, and perimeter trims shall be indicated on the Drawings in accordance with the manufacturer's standard design details.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Verify that suspension carriers are in place, suspended and leveled in a direction perpendicular to the strip direction of the engineered polymer ceiling.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction, including the following:
 - 1. Comply with ASTM C636 and seismic design requirements indicated.
 - 2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 3. Additional Hanger Wires: Wrapped tightly 3 full turns to structure and component at locations where imposed loads could cause deflection exceeding 1/360 span or tolerances specified below.
 - 4. Install vertical struts in accordance with manufacturer's shop drawings.
- B. Perimeters: Use a laser leveling device to lay out and install the perimeter trim as specified.
- C. Vertical Struts: Where struts are required, vertical struts shall be installed maximum 6 inches from each end and no greater than 3 feet on center.
- D. Direct Attach: Carriers may be direct attached to structure .
- E. Engineered Polymer Strips: Strips shall be fully attached to the carrier by snapping one side of the strip into position first, followed by the second side. When properly installed, the strips shall be firmly secured, and fully level. If applicable, end cuts are butted tight together by snapping a connector behind the strips to create a secure, aligned joint.
- F. Install access panels were indicated in accordance with manufacturer's recommendations
- G. Make final adjustments to level or contours as required.

3.3 FIELD QUALITY CONTROL

- A. Technical Service: Manufacturer shall provide installation instructions and support via video conference there needed.
- B. Upon completion of ceiling installation, the owner's representative shall inspect all finished surfaces to ensure that the work has been completed in a manner satisfactory to the owner. Any deficiencies in the install of the ceiling shall be corrected prior to substantial completion.

3.4 ADJUSTMENTS AND CLEANING

- A. Clean exposed surfaces of ceiling panel in accordance with manufacturer's instructions.
- B. Remove and replace engineered polymer strips, which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 09 65 00
RESILIENT FLOORING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient plank flooring.
 - 2. Resilient base.

1.2 SUBMITTALS

- A. Product Data: Required.
- B. Samples: Required.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Required.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.5 WARRANTY

- A. Provide manufacturer's 20 year commercial warranty for Luxury Vinyl Tile.

PART 2 PRODUCTS

2.1 LUXURY VINYL PLANK FLOORING

- A. Manufacturer: Tarkett.
 - 1. Style: Latitude.
 - 2. Color: Natural Teak.
 - e. Size: 6" x 48".
 - 4. Contact: Gwyn Noland gnoland@bpitem.com.

2.2 RESILIENT BASE

- A. Molded Rubber Base:
 - 1. Manufacturer/Style: Tarkett, inflection.
 - 2. Colors: Welsh Castle (Offices only) and Grey Haze 24.
 - 3. Size: 5-1/4".

- B. Rubber Cove Base:
 - 1. Manufacturer: Tarkett.
 - 2. Colors: Grey Haze 24.
 - 3. Size: 4".

2.2 ACCESSORIES

- A. Resilient Edge Strip (at carpet/LVT junctures): Tandus Centiva, ME-001 Metal Edge UN.
 - 1. Color: 00178 Ironstone.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify concrete floors are dry to maximum moisture content as recommended by manufacturer, and exhibit negative alkalinity, carbonization, and dusting.

3.2 PREPARATION

- A. Clean substrate.
- B. Fill minor low spots and other defects with sub-floor filler.
- C. Apply primer as required to prevent "bleed-thru" or interference with adhesion by substances that cannot be removed.
- D. Beginning of installation constitutes acceptance of subfloor.

3.3 INSTALLATION

- A. Install luxury vinyl flooring in accordance with manufacturers' instructions. Install with adhesive recommended by flooring manufacturer.
- B. Install edge strips where flooring terminates. Float up as required to provide smooth transition at tile junctures.

3.4 INSTALLATION - BASE

- A. Fit joints tightly and make vertical.
- B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.

3.5 CLEANING

- A. Remove excess adhesive from surfaces without damage.
- B. Do not wash the floor for at least four to five days after installation.

END OF SECTION

SECTION 09 68 13

TILE CARPETING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes carpet tile and accessories, fully adhered.

1.2 REFERENCES

- A. Carpet and Rug Institute:
 - 1. CRI 104 - Standard for Installation of Commercial Carpet.
 - 2. CRI Green Label Plus Testing Program.
- B. Consumer Products Safety Commission:
 - 1. CPSC 16 CFR 1630 - Standard for the Surface Flammability of Carpets and Rugs.
- C. National Fire Protection Association:
 - 1. NFPA 253 - Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Shop Drawings: Indicate layout of joints, direction of carpet pile, and location of edge moldings.
- C. Product Data: Submit data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.5 QUALITY ASSURANCE

- A. Surface Burning Characteristics:
 - 1. Floor Finishes: Comply with one of the following:
 - a. Class I, minimum 0.45 watts/sq cm when tested in accordance with NFPA 253.
 - b. CPSC 16 CFR 1630.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with minimum five years documented experience.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Store materials in area of installation for 48 hours prior to installation.

1.8 WARRANTY

- A. Furnish the following manufacturer warranties:
 - 1. Lifetime of Carpet: No More than 10% face yarn loss by weight in normal use.
 - 2. Static: Lifetime of Carpet.
 - 3. Edge Ravel: Lifetime of Carpet. Guaranteed no edge ravel in normal use (no seam sealers required)
 - 4. Delamination: Lifetime of Carpet. Guaranteed no delamination in normal use.
 - 5. Tuft Bind: Lifetime of Carpet. Guaranteed not to zipper, wet or dry.
- B. Submit installer's two year warranty to correct or replace all defects in workmanship.

1.9 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Supply 5% of carpet tiles of each color and pattern selected.

PART 2 PRODUCTS

2.1 CARPET TILE

- A. Manufacturer: J + J Industries.
 - 1. Substitutions: Not Permitted.

2.2 COMPONENTS

- A. Carpet Tile:
 - 1. Tile Size: 24 x 24 nominal.
 - 2. Pattern/Color: Craftwork.
 - 3. Color: 2201 Weaver.

2.3 ACCESSORIES

- A. Sub-Floor Filler: Type recommended by flooring material manufacturer.
- B. Moldings and Edge Strips: Refer to Section 09 65 00.
- C. Adhesive: Type recommended by carpet manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

- B. Verify floor surfaces are smooth and flat within tolerances required by carpet manufacturer, and are ready to receive work. Beginning of work constitutes acceptance of conditions.

3.2 PREPARATION

- A. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- C. Clean substrate.

3.3 INSTALLATION

- A. Install carpet tile in accordance with manufacturer's instructions and CRI 104.
- B. Do not mix carpet from different cartons unless from same dye lot.
- C. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- D. Install carpet tile in ashlar pattern, with pile direction parallel to next unit, aligned as indicated on shop drawings.
- E. Locate change of color or pattern between rooms under door centerline.
- F. Fully adhere carpet tile.
- G. Trim carpet tile neatly at walls and around interruptions.
- H. Complete installation of edge strips, concealing exposed edges.

3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Remove excess adhesive from floor, base, and wall surfaces without damage.
- C. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and field application of paints, stains, varnishes, and other coatings.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit data on products.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- D. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
- C. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

F. Provide lighting level of 80 ft candle measured mid-height at substrate surface.

1.6 SEQUENCING

A. Sequence application to the following:

1. Do not apply finish coats until paintable sealant is applied.
2. Back prime wood trim before installation of trim.

1.7 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Supply 1 gallon of each color, type, and surface texture; store where directed.
- C. Label each container with color, type, texture, room locations, in addition to manufacturer's label.

PART 2 PRODUCTS

2.1 PAINTS AND COATINGS

A. Manufacturers:

1. Benjamin Moore
2. Farrell Calhoun.
3. PPG Architectural Finishes.
4. Sherwin Williams.
5. Substitutions: Not Permitted.

2.2 COMPONENTS

- A. Coatings: Ready mixed, except field catalyzed coatings. Prepare coatings:
1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
 2. For good flow and brushing properties.
 3. Capable of drying or curing free of streaks or sags.
- B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified; commercial quality.
- C. Patching Materials: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify surfaces are ready to receive Work as instructed by product manufacturer.

- C. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.
- D. Test shop applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Gypsum Wallboard: 12 percent.
 2. Concrete Unit Masonry: 12 percent.
 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

- A. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Surfaces: Correct defects and clean surfaces capable of affecting work of this section.
- C. Marks: Seal with shellac those which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- F. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- G. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- H. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by [hand] [power tool] wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- I. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Prime metal items including shop primed items.
- J. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- K. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.
- L. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- B. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.
- C. Sand wood and metal surfaces lightly between coats to achieve required finish.
- D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- E. Where clear finishes are required, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.
- F. Prime concealed surfaces of woodwork with primer paint.
- G. Prime concealed surfaces of interior wood surfaces scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with thinner.
- H. Finishing Mechanical and Electrical Equipment:
 - 1. Refer to mechanical and electrical sections for schedule of color coding and identification banding of equipment, duct work, piping, and conduit.
 - 2. Paint shop primed equipment.
 - 3. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 - 4. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are shop finished.
 - 5. Paint interior surfaces of air ducts visible through grilles and louvers with one coat of flat black paint to visible surfaces. Paint dampers exposed behind louvers, grilles, to match face panels.
 - 6. Paint exposed conduit and electrical equipment occurring in finished areas.
 - 7. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 - 8. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated..
 - 9. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.

3.5 SCHEDULE - SHOP PRIMED ITEMS FOR SITE FINISHING

- A. Paint exposed lintels, gas piping, and any other exposed metals on the exterior.
- B. Paint exposed surfaces of stringers, exposed vertical risers, and elevator pit ladder.

3.6 SCHEDULE - EXTERIOR SURFACES

- A. Pavement Markings: Refer to civil specifications.
- B. Concrete, Concrete Block:
 - 1. One coat of heavy duty block filler.
 - 2. Two coats of latex enamel, sprayed then rolled to achieve solid coverage with no “pin holes”.
- C. Steel - Unprimed:
 - 1. One coat of latex primer.
 - 2. Two coats of latex enamel, semi-gloss.
- D. Steel - Shop Primed:
 - 1. Touch-up with zinc chromate primer.
 - 2. Two coats of latex enamel, semi-gloss.
- E. Steel - Galvanized:
 - 1. One coat galvanize primer.
 - 2. Two coats of latex enamel, semi-gloss.

3.8 SCHEDULE - INTERIOR SURFACES

- A. Wood - Painted:
 - 1. One coat of alkyd prime sealer.
 - 2. Two coats of alkyd enamel, semi-gloss.
- B. Wood - Transparent:
 - 1. Filler coat (for open grained wood only).
 - 2. One coat of stain.
 - 3. One coat of sealer.
 - 4. Two coats of varnish, gloss.
- C. Steel - Unprimed:
 - 1. One coat of latex enamel primer.
 - 2. Two coats of latex enamel, semi-gloss.
- D. Steel - Primed:
 - 1. Touch-up with latex enamel primer.
 - 2. Two coats of latex enamel, semi-gloss.
- E. Steel - Galvanized:
 - 1. Touch-up with one coat of galvanize primer.
 - 2. Two coats of latex enamel, semi-gloss.
- F. Gypsum Board Walls:
 - 1. One coat of latex primer sealer.
 - 2. Two coats of latex acrylic enamel, satin.
- G. Gypsum Board Walls to Receive Vinyl Wallcovering:
 - 1. One coat latex primer sealer.

- H. Gypsum Board Ceilings:
 - 1. One coat of latex primer sealer.
 - 2. Two coats of latex acrylic enamel, eggshell.

3.7 SCHEDULE – COLORS

- A. Main Wall Paint: SW 7029 Agreeable Gray
- B. Accent Paint (blue): Farrell Calhoun, 0534 Subtle Shadow.
- C. Accent Paint (taupe): Farrell Calhoun, 0218 Drifting Sand.

END OF SECTION

SECTION 10 00 00

SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rapid entry system.

1.2 SUBMITTALS

- A. Product Data: Required.

PART 2 PRODUCTS

2.1 RAPID ENTRY SYSTEM

- A. Provide a knox box with tamper proof switch, clear anodized finish, recessed mounted.

PART 3 EXECUTION

3.1 INSTALLATION – KNOX BOX

- A. Install knox box on the exterior wall, in location satisfactory to the Fire Marshall.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Interior restroom signs. Exterior signs are N.I.C.
 - 2. Vinyl letters/numbers.
- B. Related Sections:
 - 1. Section 23 01 90 - Mechanical Identification

1.2 REFERENCES

- A. Conform to the following:
 - 1. Department of Justice, Office of the Attorney General, "Americans with Disabilities Act", Public Law 101-336, (ADA).
 - 2. ANSI A117.1: Providing Accessibility and Useability for Physically Handicap People, 1986 edition.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, overall dimensions of each sign.
- C. Samples: Submit color chips (photos of colors are not acceptable) for selection by Architect.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Package signs, labeled in name groups.
- C. Store adhesive attachment tape at ambient room temperatures.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install signs when ambient temperature is lower than recommended by manufacturer.
- C. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 INTERIOR SIGNS

- A. Manufacturers:
 - 1. ASI Sign Systems.
 - 2. DFI
 - 3. Archway Graphics
 - 4. Mohawk
 - 5. Substitutions: Section 01 60 00 - Product Requirements.

- B. Signs: Clear Acrylic Face, in matte (non-glare) finish.
 - 1. Backing Plate: Acrylic.
 - 2. Sign Color: Mohawk, #321 Brittany Blue.
 - 3. Character Color: White..
 - 4. Height: As required to fit on sign.
 - 5. Edges: Radiused.
 - 6. Character Font: Helvetica.
 - 7. Provide braille to meet ADA.

- C. Restroom Signs:
 - 1. Description: HC symbol, message with Braille.
 - 2. Approximate Size: 8" x 8"
 - 3. Quantity: At each restroom.

2.2 VINYL LETTERS/ NUMBERS

- A. Provide 6" high vinyl numbers with the address on the glass over entry doors, and at Community Room entry, as shown on Drawings.

2.3 ACCESSORIES

- A. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install signs and letters after surfaces are finished, in locations as directed by Architect/Engineer.

- B. Position restroom sign on strike side of door. Position sign 60 inches above the finished floor to the centerline of the sign.

- C. Locate sign on wall surface, level.

END OF SECTION

SECTION 10 26 00

WALL PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Corner guards.

1.2 SUBMITTALS

- A. Product Data: Required.
- B. Samples: Required.

PART 2 PRODUCTS

2.1 CORNER GUARDS

- A. Manufacturers:
 - 1. C/S Group.
 - 2. InPro Corporation.
 - 3. Koroseal Wall Protection Systems, Inc.
 - 4. Pawling Corp.
 - 5. Substitutions: Permitted.

2.2 COMPONENTS

- A. Corner Guard Surface Mounted: High impact vinyl, with 1-1/2" wing.
 - 1. Height: From top of base to ceiling.
 - 2. Color: Inpro Taupe 0113, or approved equal.
- B. Mounting Brackets and Attachment Hardware: Appropriate to component and substrate.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Position corner guard from top of base to ceiling.
- B. Provide adhesive as recommended by manufacturer, if required, for a secure installation.

END OF SECTION

SECTION 10 28 00

TOILET ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Toilet accessories.

1.2 DESIGN REQUIREMENTS

- A. Design grab bars and attachments to resist forces as required by applicable code.

1.3 SUBMITTALS

- A. Product Data: Required.

PART 2 PRODUCTS

2.1 TOILET ACCESSORIES

- A. Manufacturers:
 - 1. A & J Washroom Accessories.
 - 2. American Specialties, Inc.
 - 3. Bobrick.
 - 4. Bradley Corp.
 - 5. Substitutions: Not Permitted.

2.2 COMPONENTS

- A. Keys: Furnish 3 keys for each accessory to Owner; master key accessories.
- B. Stainless Steel Sheet: ASTM A666, Type 304.
- C. Stainless Steel Tubing: ASTM A269, stainless steel.
- D. Mirror Glass: Float glass, with silvering, copper coating, and suitable protective organic coating.
- E. Adhesive: As recommended by manufacturer.

2.3 TOILET ROOM ACCESSORIES

- A. Refer to Schedule at end of this Section.

2.4 FACTORY FINISHING

- A. Stainless Steel: No. 4 satin brushed.
- B. Chrome/Nickel Plating: ASTM B456, satin finish.

- C. Galvanizing: ASTM A123/A123M.
- D. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install plumb and level, securely and rigidly anchored to substrate.
- B. Mounting Heights and Locations: As required by accessibility regulations and as follows:
 - 1. Bottom of Mirrors: 40" to bottom of reflective surface.
 - 2. Horizontal Grab Bars: Centerline 36" AFF.
 - 3. Vertical Grab Bar: Bottom mounted at 40" AFF, centerline 40" from back wall.
 - 4. Toilet Paper Dispenser: Centerline 24" AFF, 30" from back wall.
 - 5. Paper Towel Dispenser: Bottom at 48" AFF max.

3.2 SCHEDULES

- A. Grab Bars: 1-1/2" clearance, concealed mounting, one 42" and one 36" horizontal, and one 18" vertical at each handicapped water closet.
 - 1. ASI 3800 Series
 - 2. Bobrick B-6206
 - 3. Bradley 812 Series
- B. Toilet Paper Dispensers: Double unit, one at each water closet.
 - 1. ASI 7305-2
 - 2. Bobrick B-686
 - 3. Bradley 5234
- C. Combination Paper Towel Dispenser/Waste Receptacles: Semi-recessed. Provide one at each restroom and Lactation Room.
 - 1. ASI 0467 (7 gallons): Mount bottom 40" AFF.
 - 2. Bobrick B- 3942 (12 gallons): Mount 60 1/2" to top of unit.
 - 3. Bradley 2252 (5.75gallons): Mount top 57 1/2" AFF.
- D. Soap Dispensers: N.I.C.
- F. Mirrors: Refer to Section 08 80 00 for mirrors, and refer to Drawings for wood frame surrounds.
- G. Mop and Broom Holder: Provide one at each Janitor's Room.
 - 1. ASI 1315
 - 2. Bobrick B-239 x 34
 - 3. Bradley 9984

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes fire extinguishers and fire extinguisher cabinets.

1.2 REFERENCES

- A. National Fire Protection Association:
 - 1. NFPA 10 - Standard for Portable Fire Extinguishers.
- B. Underwriters Laboratories Inc.:
 - 1. UL - Fire Protection Equipment Directory.

1.3 PERFORMANCE REQUIREMENTS

- A. Conform to NFPA 10 code.
- B. Provide extinguishers and cabinets classified and labeled by testing firm acceptable to authority having jurisdiction for purpose specified and indicated.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, and fire ratings where applicable.
- C. Product Data: Submit extinguisher operational features, color and finish, anchorage details size.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements.
- B. Operation and Maintenance Data: Submit test, refill or recharge schedules and re-certification requirements.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install extinguishers when ambient temperature is capable of freezing extinguisher ingredients.

PART 2 PRODUCTS

2.1 FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. JL Industries.
 - 2. Larsen's Manufacturing Co.
 - 3. Potter Roemer.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Type: Cast steel tank, with pressure gage.
 - 1. Quantity: 2.

2.2 FIRE EXTINGUISHER CABINETS

- A. Manufacturers:
 - 1. Larsen's
 - 2. J. L. Industries
 - 3. Substitutions: Section 01 60 00 - Product Requirements .
- B. Finish: Formed stainless steel; fire rated where shown in fire rated partitions.
- C. Configuration: Semi-recessed type, sized to accommodate extinguisher.
- D. Trim Type: Returned to wall surface, with 4-1/2 inch projection.
- E. Door: Full glass.
- F. Door Glazing: Glass, clear, 1/8 inch thick tempered.
- G. Cabinet Mounting Hardware: Appropriate to cabinet.
- H. Form cabinet enclosure with right angle inside corners and seams.
- I. Weld, fill, and grind components smooth.
- J. Quantity: 2.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. Install cabinets plumb and level in wall openings, 48 inches from finished floor to top of extinguisher handle.
- B. Secure rigidly in place.

C. Place extinguishers in cabinets.

END OF SECTION

SECTION 12 20 00

WINDOW SHADES

PART 1 GENERAL

1.1 SUMMARY

- A. Provide window shades and accessories as follows:
 - 1. Shade fabric: Fire resistant, openness factor as required by orientation and glazing; single sunscreen shadeband with specified weave.
 - 2. Operation / Manual: Offset side-mounted chain operator for manual operation as either single-band or multi-band shades.
 - 3. Mounting: Ceiling mounted to structure or brackets mounted to structure in gypsum wallboard coves; provide closure trim.
 - 4. Shade Orientation: Regular roll, shade cloth falls at window side of roller.
 - 5. Configuration: Single band per windows opening.
 - 6. Accessories without exposed fastening: Snap-on facia.

1.2 SUBMITTALS

- A. Shop Drawings: Include typical elevation layout, shade fabrication, fasteners, installation methods and clearance for mounting condition.
- B. Samples: Submit minimum 5" x 6" fabric samples and samples of exposed metal finishes.

1.3 QUALITY ASSURANCE

- A. Provide shade system as a complete unit produced by one manufacturer, including hardware, accessory items, mounting brackets and fastening.
- B. Provide products of acceptable manufacturers with satisfactory use in similar service for three years. Use experienced installers.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle and store materials in accordance with manufacturer's instructions.

1.5 WARRANTY

- A. Five year warranty on manually operated components, except bead chain which is a maintenance / service item.
- B. Five year warranty on shade cloth with provision that it will not deteriorate, sag or warp and will remain fit for use for the full warranty period when used as an interior rollershade.
- C. Provide five year warranty for hardware components to be free from defects in material and workmanship under the normal and proper use.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufacturer: Mechoshade or Pfiefer.
- B. Shade Cloth: Mechoshade, Soho, #1116 Spring/Slate.
- C. Manual Shade System: Pre-engineered unit with one-piece molded sprockets and a linear disc brake opposed to a flat steel backing plate and concealed variable-adjustment mechanism. Shade mechanism shall be adjustable from 100% friction (static mode) with infinite positions to 15% friction (dynamic mode) with only pre-selected positions. The operator shall be a side-mounted gear and sprocket mechanism located within the drive-end bracket. The shade cloth shall be removable with a snap-on and snap-off mounting (Snap-Loc™) spline without having to remove the shade tube.
- D. SnapLoc™ Fascia
 - 1. Extruded aluminum pocket with exposed tile support and pocket closure with baked-enamel finish.
 - 2. Accessibility by removing closure. No exposed screws or mounting means. Pocket shall be sized for single shadeband.
- E. Location: Refer to Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify mounting surface acceptability, installation conditions, and field measurements.
- B. Take field measurements prior to the fabrication to ensure fit.

3.2 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals.
- B. Install level and plumb.

END OF SECTION

SECTION 12 48 13

ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Carpet mat and frame set flush with porcelain tile.

1.2 SUBMITTALS

- A. Shop Drawings: Required.
- B. Product Data: Required.
- C. Samples: Required.

PART 2 PRODUCTS

2.1 FLOOR MATS

- A. Manufacturers: This specification is based on Pedimat, by Construction Specialties. Equal or superior products may be considered for substitution.

2.2 COMPONENTS

- A. Frame: The actual frame is not recessed into the concrete. However, an aluminum angle frame is required for an installation flush with the adjacent porcelain tile.
- B. Tread Inserts: Solution dyed, 100% nylon carpet; fibers fusion bonded to rigid two-ply backing.
- C. Rails: Rigid vinyl/acrylic, with cushions
- D. Hinge Rail connectors: Clear anodized aluminum.
- E. Carpet: CS 7324 Gunmetal, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

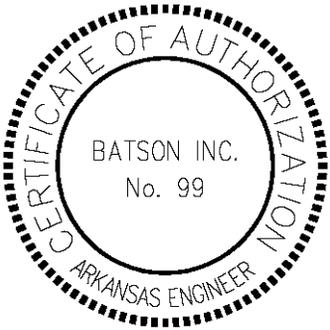
- A. Install mat frames to achieve flush plane with finished floor surface.

END OF SECTION

SPECIFICATIONS: DIVISION 22 and 23
PROJECT: First Community Bank – Lepanto, AR
DATE: February 8, 2023
BATSON INC. PROJECT NO.: 5886



Milton Canizares, P.E.



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FIRST COMMUNITY BANK
Lepanto, AR

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SECTION 22 05 17

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

2.02 SLEEVE-SEAL SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.

- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
 - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.03 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:
 - a. Piping Smaller than NPS 8: Cast-iron wall sleeves.

END OF SECTION

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Bronze gate valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.02 SUBMITTALS

- ###### A. Product Data: For each type of valve indicated.

1.03 QUALITY ASSURANCE

- ###### A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- ###### B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- ###### A. Refer to valve schedule articles for applications of valves.
- ###### B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- ###### C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- ###### D. Valve Actuator Types:
1. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller.
- ###### E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Solder Joint: With sockets according to ASME B16.18.

2.02 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

2.03 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollow Valves.
 - c. Kitz Corporation.
 - d. Watts Regulator Co.; a division of Watts Walter Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-72
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Ends: Flanged.
 - f. Seats: PTFE or TFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.
 - i. Port: Full.

2.04 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.05 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Legend Valve.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC>
 - j. Powell Valves.
 - k. Red-White Valve corporation.
 - l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.

2. Description:
 - a. Standard: MSS SP-70, Type I
 - b. CWP Rating: 200 psig (1380kPa).
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.01 VALVE INSTALLATION

- A. Install valves with unions at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.02 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, or gate valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, with the following end connections:
 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: solder-joint valve.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Threaded valve-end option.

3.04 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 1. Bronze Valves: provided with solder-joint ends.
 2. Ball Valves: Two piece, full port, bronze with bronze trim.
 3. Bronze Gate Valves: Class 125, NRS.
- B. Pipe NPS 2-1/2 to NPS 4 (DN 65 to DN 100)
 1. Iron Valves: Provide with threaded or flanged ends.
 2. Iron Ball Valves: Class 150.
 3. Iron Gate Valves: Class 125, NPS

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

1.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
 2. Equipment supports.
- C. Welding certificates.

1.04 QUALITY ASSURANCE

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

- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.02 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.03 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.04 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.05 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.06 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.07 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.05 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

- Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.

1.02 SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
 2. Letter Color: Black.
 3. Background Color: Yellow.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Domestic Water Piping (Cold Water / Hot Water / Hot Water Return):
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 2. Gas piping (Natural Gas):
 - a. Background Color: Yellow.
 - b. Letter Color Black.
 - 3. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Blue
 - b. Letter Color: White

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold, hot-water and hot-water recirculation piping.
 - 2. Supplies and drains for handicap-accessible lavatories and sinks.
 - 3. Sanitary waste piping exposed to freezing conditions.
 - 4. Storm-water piping exposed to freezing conditions and horizontal piping within building.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Glass-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 Deg F (454 Deg C) Materials: glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 INSULATING CEMENTS

- A. Glass-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.
- C. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
 - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.05 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.06 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.07 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.

- d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
- 2. Width: 3 inches (75 mm).
- 3. Thickness: 11.5 mils (0.29 mm).
- 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
- 5. Elongation: 2 percent.
- 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
- 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.08 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, [1/2 inch (13 mm)] [3/4 inch (19 mm)] wide with closed seal.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches (50 mm)] [4 inches (100 mm)] o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.03 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.04 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.05 INSTALLATION OF GLASS-FIBER PREFORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.06 FINISHES

- A. Do not field paint aluminum or stainless-steel jackets.

3.07 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Underground piping.
 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.08 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold, Hot Water and Hot Water Return: Insulation shall be the following:
1. Glass-Fiber, Preformed Pipe Insulation, Type I: ½ thickness for runouts, 1" thick for pipe sizes up to 2", and 1-1/2" thick for pipe sizes greater than 2".
- B. Internal Storm Drain (Horizontal Above-Grade). Insulation shall be the following:
1. Owens-Corning 1" thick Fiberglas, one piece, pipe insulation with factory-applied White All-Service (ASJ) Vapor Barrier Jacket. Fittings shall be molded or mitered Fiberglas. Insulate bottom of drain pot exposed, insulate elbow at connection to drain in horizontal run including the elbow to vertical.

3.09 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Cold, and Make Up Water Piping: Insulation shall be the following:

1. Glass – Fiber, preformed pipe insulation, Type I: 2 inches (50 mm) thick.
 - B. Sewer lines subject to freezing: Refer to drawing. Insulate over heat trace same as for cold water.
 - C. Storm lines subject to freezing: Refer to drawing. Insulate over heat trace same as for cold water.
- 3.10 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
 - B. Piping Exposed (Outdoors and parking deck):
 1. Aluminum, 0.020 inch (0.51) mm thick.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Specialty valves.
3. Flexible connectors.

1.02 SUBMITTALS

- ###### A. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE

- ###### A. Piping materials shall bear label, stamp, or other marking of specified testing agency.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- ###### A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 COPPER TUBE AND FITTINGS

- ###### A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.03 DUCTILE-IRON PIPE AND FITTINGS

- ###### A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.04 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

2.05 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

2.06 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.

2.07 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Description:
 - a. Pressure Rating: 150 psig (1035 kPa) at 180 deg F (82 deg C).
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.

D. Dielectric Flanges:

1. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

E. Dielectric Nipples:

1. Description:

- a. Electroplated steel nipple.
- b. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
- c. End Connections: Male threaded or grooved.
- d. Lining: Inert and noncorrosive, propylene.

2.08 FLEXIBLE CONNECTORS

F. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

G. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install domestic water piping level and plumb.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping adjacent to equipment and specialties to allow service and maintenance.
- J. Install piping to permit valve servicing.
- K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.02 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

3.03 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

3.04 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
 - 2. NPS 2 (DN 50) and Larger: Sleeve-type coupling.

3.05 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.

3.06 FLEXIBLE CONNECTOR INSTALLATION

- A. Install bronze-hose flexible connectors in copper domestic water tubing.
- B. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.07 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - 3. Base of Vertical Piping: MSS Type 52, spring hangers.

- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 Feet (3m) with 1/2-inch (13-mm) rod.
- E. Install supports for vertical copper tubing every 10 feet (3 m).
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.08 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.09 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 4 (DN 100) and smaller, shall be the following:
 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) wrought- copper solder-joint fittings; and soldered joints.
- D. Under-building-slab, domestic water, building-service piping, NPS 4 (DN 100), shall be the following:
 1. Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.

3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use ball or gate valves for piping NPS 3 (DN 65) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 4 (DN 100).
 2. Drain Duty: Hose-end drain valves.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. Dallas Specialty & Mfg. Co.
 - d. MIFAB, Inc.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Stant.
 - g. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and ASTM C 1540.

2.03 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
 - 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Solvent Cement: ASTM D 2564.
 - 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.04 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

- J. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- K. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."
- P. Install underground PVC piping according to ASTM D2321.

3.02 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.03 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Shielded, nonpressure transition couplings.

3.04 VALVE INSTALLATION

- A. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.

3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 4. Install individual, straight, horizontal piping runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 (DN 150): 60 inches (1500mm) with 3/4-inch (19-mm) rod.
 5. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.07 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.08 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.09 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 6 and smaller shall be the following:
 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
- C. Aboveground, vent piping NPS 4 and smaller shall be the following:
 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
- D. Underground, soil and waste, piping NPS 6 and smaller shall be the following:
 1. Solid-wall PVC Pipe; PVC socket fittings; and solvent-cemented joints.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Roof flashing assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.
7. Grease interceptors.

1.02 ACTION SUBMITTALS

- ###### A. Product Data:
- For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.03 QUALITY ASSURANCE

- ###### A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.

4. Body: Cast iron.
5. Cover: Cast iron with [bolted] access check valve.
6. End Connections: [Hub and spigot].
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang [closed].
8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Size: Same as floor drain outlet.
3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

2.02 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:

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. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Drainage Products.
 - f. Zurn Plumbing Products Group.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:

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. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for adjustable housing, cast-iron soil pipe with cast-iron ferrule cleanout.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
6. Outlet Connection: Inside calk.
7. Closure: Brass plug with straight threads and gasket.
8. Adjustable Housing Material: Cast iron with threads or set-screws or other device.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Heavy Duty.
12. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

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. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee] as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.
8. Wall Access: Round nickel-bronze or stainless-steel wall-installation frame and cover.

2.03 FLOOR DRAINS

A. Cast-Iron Floor Drains:

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. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Nickel bronze.
13. Top of Body and Strainer Finish: Nickel bronze.
14. Top Shape: Round.
15. Top Loading Classification: Heavy Duty.
16. Funnel: Not required.
17. Inlet Fitting: Not required.
18. Trap Material: Cast iron.
19. Trap Pattern: Deep-seal P-trap.
20. Trap Features: Cleanout

2.04 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
2. Description: Manufactured assembly made of [4.0-lb/sq. ft., 0.0625-inch-] thick, lead flashing collar and skirt extending at least [8 inches] from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

2.05 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
 2. Size: Same as connected waste piping or with increaser fitting of size indicated.
- B. Deep-Seal Traps:
1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- C. Floor-Drain, Trap-Seal Primer Fittings:
1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- D. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- E. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend [1 inch] above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 2. Size: As required for close fit to riser or stack piping.
- F. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 2. Size: Same as connected stack vent or vent stack.
- G. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 2. Size: Same as connected stack vent or vent stack.

2.06 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 - 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

- E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- G. Assemble open drain fittings and install with top of hub 1 inch above floor.
- H. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- L. Install vent caps on each vent pipe passing through roof.
- M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.02 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.03 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.04 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.05 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 14 13

FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.04 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.

2.03 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:

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. ANACO-Husky.
 - b. MIFAB, Inc.
 - c. Mission Rubber Company; a division of MCP Industries, Inc.
 - d. Tyler Pipe.
2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Solvent Cement: ASTM D 2564
 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)
 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources using Small-Scale Environmental Chambers".

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Storm-Drainage Piping: 1 percent downward in direction of flow.
- J. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- K. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
 - 2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- P. Install underground PVC piping according to ASTM D 2321.

3.02 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.
 - 3. Up to and including first elbow: Service class, cast-iron soil-pipe and fittings; gaskets; and gasketed joints.
 - 4. Downstream of first elbow: Solid-wall PVC pipe, PVC socket fittings, and solvent cemented joints.

3.03 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 4. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 - 6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.

- G. Install supports for vertical copper tubing every 10 feet.
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.04 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect storm drainage piping to roof drains and storm drainage specialties.
 - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
 - 2. Comply with requirements for cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."
- C. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.05 IDENTIFICATION

- A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.06 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Test Procedure: Test storm drainage piping, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-

foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.07 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.08 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 10 and smaller shall be any of the following:
 1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
- C. Underground storm drainage piping NPS 16 and smaller shall be the following.
 1. Up to and including first elbow: Service class, cast-iron soil-pipe and fittings; gaskets; and gasketed joints.
 2. Downstream of first elbow: Solid-wall PVC pipe, PVC socket fittings, and solvent cemented joints.

END OF SECTION

SECTION 22 14 23

STORM DRAINAGE PIPING SPECIALTIES

1.01 SUMMARY

- A. Section Includes:
 - 1. Roof drains.
 - 2. Miscellaneous storm drainage piping specialties.
 - 3. Flashing materials.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 METAL ROOF DRAINS

- A. Refer to schedule on the drawings.

2.02 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- A. Conductor Nozzles:
 - 1. Refer to schedule on the drawings.

2.03 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft..
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

- F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Install expansion joints, if indicated, in roof drain outlets.
 - 3. Position roof drains for easy access and maintenance.
- B. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- C. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
 - 1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
 - 3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate cleanouts at base of each vertical soil and waste stack.
- D. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

3.02 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.03 FLASHING INSTALLATION

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches and with skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.

3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.04 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 23 05 17

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.02 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Advance Products & Systems, Inc.
 2. Metraflex Company (The).
 3. Pipeline Seal and Insulator, Inc.
 4. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

2.03 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.03 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves or Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves or Galvanized-steel-pipe sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.

- 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
 5. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

SECTION 23 05 18

ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.02 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

- b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.

3.02 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 23 05 23

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. High-performance butterfly valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Iron swing check valves with closure control.
8. Bronze gate valves.
9. Iron gate valves.
10. Bronze globe valves.
11. Iron globe valves.
12. Chainwheels.

B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.02 ACTION SUBMITTALS

- ###### A. Product Data: For each type of valve indicated.

1.03 QUALITY ASSURANCE

- ###### A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- ###### B. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- ###### A. Refer to HVAC valve schedule articles for applications of valves.

- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.

2.02 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Legend Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.

- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

2.03 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

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. Cooper Cameron Valves; a division of Cooper Cameron Corp.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Legend Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Norriseal; a Dover Corporation company.
 - i. Spence Strainers International; a division of CIRCOR International.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

2.04 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.05 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Legend Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.

2.06 BRONZE GATE VALVES

A. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.

- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded[or solder joint].
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron.

2.07 IRON GATE VALVES

A. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Legend Valve.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. NPS 14 to NPS 24, CWP Rating: 150 psig.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Disc: Solid wedge.
- h. Packing and Gasket: Asbestos free.

2.08 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded[or solder joint].
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron.

2.09 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-85, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.

2.10 CHAINWHEELS

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. Babbitt Steam Specialty Co.
- 2. Roto Hammer Industries.
- 3. Trumbull Industries.

- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to butterfly valve stems.
 - 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.[Include zinc coating.]
 - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for[gate] [and] [globe] valves [NPS 4] and larger and more than [96 inches] above floor. Extend chains to [60 inches] above finished floor.
- F. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.03 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate valves.
 - 2. Throttling Service, Except Steam: Globe, ball, or butterfly valves.
 - 3. Throttling Service, Steam: Globe valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with [bronze] disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.05 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two piece, full port, with bronze trim.
 - 3. Bronze Swing Check Valves: Class 125, bronze disc.
 - 4. Bronze Gate Valves: Class 125, RS, bronze.
 - 5. Bronze Globe Valves: Class 125, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, (EPDM) seat, aluminum-bronze disc.
 - 3. Iron Swing Check Valves: Class 125 metal seats.
 - 4. Iron Gate Valves: Class 125 OS&Y.
 - 5. Iron Globe Valves: Class 125.

3.06 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, with bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, RS.
5. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron Gate Valves: Class 125 OS&Y.
5. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Equipment supports.

1.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Welding certificates.

1.04 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.02 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.03 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.04 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.05 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- F. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, [NPS 2-1/2] and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- K. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - b. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 3. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
- 4. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to [1-1/2 inches].

3.05 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 3. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 - 4. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

END OF SECTION

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.

1.02 SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel [rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.02 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 - 1. Refrigerant Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 - 2. Condensate Drain Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 - 3. Chilled-Water Piping (Supply and Return)
 - a. Background Color: Green
 - b. Letter Color: White
 - 4. Heating Hot-Water Piping (Supply and Return):

- a. Background Color: Yellow
- b. Letter Color: Black

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.

1.02 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TAB Specialist: An entity engaged to perform TAB Work.

1.03 INFORMATIONAL SUBMITTALS

- A. Certified TAB reports.

1.04 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

- C. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.

- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure total airflow.

- a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

3.07 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check liquid level in expansion tank.
 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.08 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Engineer and comply with requirements in Section 232123 "Hydronic Pumps."
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated

brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presets.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.09 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.11 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.12 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.13 PROCEDURES FOR COOLING TOWERS

- A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:

1. Measure condenser-water flow to each cell of the cooling tower.
2. Measure entering- and leaving-water temperatures.
3. Measure wet- and dry-bulb temperatures of entering air.
4. Measure wet- and dry-bulb temperatures of leaving air.
5. Measure condenser-water flow rate recirculating through the cooling tower.
6. Measure cooling-tower spray pump discharge pressure.
7. Adjust water level and feed rate of makeup water system.
8. Measure flow through bypass.

3.14 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.15 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.
- B. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

3.16 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperature at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - 5. Calculated kilowatt at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each steam coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Airflow.
 - 3. Air pressure drop.
 - 4. Inlet steam pressure.
- D. Measure, adjust, and record the following data for each refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.
 - 4. Air pressure drop.
 - 5. Refrigerant suction pressure and temperature.

3.17 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 10 percent.
 - 4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.18 REPORTING

- A. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.19 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.

- c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.

3.20 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, concealed return located in unconditioned space.
 - 3. Outdoor, concealed supply and return.
 - 4. Outdoor, exposed supply and return.

- B. Related Sections:
 - 1. Section 230716 "HVAC Equipment Insulation."
 - 2. Section 230719 "HVAC Piping Insulation."
 - 3. Section 233113 "Metal Ducts" for duct liners.

1.02 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

- E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.03 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F.

3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.04 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg. F.
 4. Color: Aluminum.
 5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.05 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.06 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
1. Finish and thickness are indicated in field-applied jacket schedules.
 2. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper 2.5-mil- thick polysurlyn.

2.07 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches.
 2. Thickness: 6.5 mils
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.

2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.08 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with closed seal.
- B. Insulation Pins and Hangers:
 1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Aluminum fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - b. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive-backed base with a peel-off protective cover.
 4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, [galvanized-steel] [aluminum] [stainless-steel] sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

- a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- 5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.03 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.04 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment.

Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.05 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.06 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.07 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Indoor, concealed supply and outdoor air.
 2. Indoor, concealed return located in unconditioned space.
- B. Items Not Insulated:
 1. Fibrous-glass ducts.
 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 3. Factory-insulated flexible ducts.

4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.
8. Exhaust Ducts.

3.08 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Round, Flat-Oval and Rectangular Supply-Air Duct Insulation: Mineral-fiber blanket 2 inches thick and 0.75-lb/cu. ft. nominal density.
- B. Concealed, Round, Flat-Oval and Rectangular Return-Air Duct Insulation: Mineral-fiber blanket 2 inches thick and 0.75-lb/cu. ft. nominal density.
- C. Concealed, Round, Flat-Oval and Rectangular Outdoor-Air Duct Insulation: Mineral-fiber blanket 2 inches thick and 0.75-lb/cu. ft. nominal density.
- D. Concealed Rectangular (within 25 ft of air handler) Supply-Air and Return-Air Duct and Plenum: Flexible Elastomeric, 1 inch thick.

END OF SECTION

SECTION 23 07 16

HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes insulating the following HVAC equipment that is not factory insulated:

1. Heat exchangers.
2. Chilled-water pumps.
3. Heating, hot-water pumps.
4. Expansion/compression tanks.
5. Air separators.
6. Buffer Tanks.

B. Related Sections:

1. Section 230713 "Duct Insulation."
2. Section 230719 "HVAC Piping Insulation."

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail removable insulation at equipment connections.
4. Detail application of field-applied jackets.
5. Detail application at linkages of control devices.
6. Detail field application for each equipment type.

1.03 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 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. Pittsburgh Corning Corporation; Foamglas.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Board Insulation: ASTM C 552, Type IV.
 5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Sheet and K-FLEX LS.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 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. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Knauf Insulation; Friendly Feel Duct Wrap.
 - c. Owens Corning; SOFTR All-Service Duct Wrap.
- H. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
- 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. Industrial Insulation Group (IIG); MinWool-1200 Flexible Batt.
 - b. Johns Manville; HTB 26 Spin-Glas.
 - c. Roxul Inc.; Roxul RW.
- I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- 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. CertainTeed Corp.; CertaPro Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Owens Corning; Fiberglas 700 Series.
- J. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
- 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. Fibrex Insulations Inc.; FBX.
 - b. Industrial Insulation Group (IIG); MinWool-1200 Industrial Board.
 - c. Rock Wool; Delta Board.
- K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- 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. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 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. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 - 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. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.
 - 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. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- 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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 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. Foster Brand, Specialty Construction Brands, Inc., a business of H .B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.05 SEALANTS

- A. Joint Sealants:
1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Pittsburgh Corning Corporation; Pittseal 444.
- B. FSK and Metal Jacket Flashing Sealants:
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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.06 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 - 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) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
4. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.07 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for equipment.

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. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.

2.08 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Sheet and roll stock ready for shop or field sizing..
 3. Finish and thickness are indicated in field-applied jacket schedules.
 4. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 6. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- D. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with [white] aluminum-foil facing.
 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. Polyguard Products, Inc.; Alumaguard 60.

2.09 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
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. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
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. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
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. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
- B. Insulation Pins and Hangers:
1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - 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) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - 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) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

- 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) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers, Series.
 - 2) GEMCO; Peel & Press.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: [Copper- or zinc-coated, low-carbon steel], fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, [galvanized-steel] sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: [0.080-inch nickel-copper alloy].
- 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. C & F Wire.

2.11 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches] o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.03 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches.
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.040 thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.04 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.05 FINISHES

A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections.

- B. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to [one] location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.07 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment that is not factory insulated.
- C. Chilled-water pump insulation shall be one of the following:
 - 1. Cellular Glass: 3 inches thick.
 - 2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- D. Heat-Exchanger (Water-to-Water for Heating Service) Insulation: Mineral-fiber pipe and tank, 2 inches thick.
- E. Heating-Hot-Water Pump Insulation: Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- F. Chilled-water expansion/compression tank insulation shall be the following:
 - 1. Mineral-Fiber Pipe and Tank: Same as attached piping insulation.
- G. Heating-Hot-Water Expansion/Compression Tank Insulation: Mineral-Fiber Pipe and Tank: Same as attached piping insulation.
- H. Chilled-water air-separator insulation shall be the following:
 - 1. Mineral-Fiber Pipe and Tank: Same as attached piping insulation.
- I. Heating-Hot-Water Air-Separator Insulation: Mineral-Fiber Pipe and Tank: Same as attached piping insulation.
- J. Chilled-water buffer tank insulation shall be the following:
 - 1. Mineral fiber pipe and tank: Same as attached piping insulation.

3.08 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.

- C. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - 1. Aluminum, Smooth 0.024 inch thick.

- D. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
 - 1. Aluminum, Smooth with 1-1/4-Inch- Deep Corrugations: 0.040 inch thick.

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 - 1. Chilled-water piping, indoors and outdoors.
 - 2. Heating hot-water piping, indoors and outdoors.
 - 3. Refrigerant suction and hot-gas piping, indoors and outdoors.
 - 4. Condensate drain piping, indoors and outdoors.

- B. Related Sections:
 - 1. Section 230713 "Duct Insulation."
 - 2. Section 230716 "HVAC Equipment Insulation."

1.02 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

- D. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

E. Mineral-Fiber, Preformed Pipe Insulation:

1. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
 2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 3. Solids Content: 60 percent by volume and 66 percent by weight.
 4. Color: White.

2.05 SEALANTS

- A. Joint Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Permanently flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
 4. Color: White or gray.
 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 4. Color: White.
 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.06 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.07 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

- B. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - 1. Finish and thickness are indicated in field-applied jacket schedules.
 - 2. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

2.08 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Width: 3 inches (75 mm).
 - 2. Thickness: 11.5 mils (0.29 mm).
 - 3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.09 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) [4 inches (100 mm)] o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.03 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.04 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and

unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.05 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.06 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.07 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.08 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.09 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Drainage piping located in crawl spaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Chilled Water, above 40 Deg F (5 Deg C): Insulation shall be the following:
 1. Mineral-Fiber, Preformed Pipe, Type I 1-1/2 inches (38 mm) thick.

- B. Condenser-Water Supply and Return: Insulation shall be the following:
 - 1. Mineral-Fiber, Preformed Pipe, Type I 1-1/2 inches (38mm) thick.
- C. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and Below: Insulation shall be the following:
 - 1. Mineral-Fiber, Preformed Pipe, Type I: 1 1/2 inches (38 mm) thick.
- D. Refrigerant Suction and Hot-Gas Piping Insulation shall be the following:
 - 1. Flexible elastomeric 1 inch (25 mm) thick.
- E. Condensate Drain Piping:
 - 1. Mineral-Fiber, preformed pipe, type 1 1/2 inch (12mm) thick..

3.11 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Chilled Water: Insulation shall be the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (75 mm) thick.
- B. Condenser-Water Supply and Return: Insulation Shall be the following:
 - 1. Mineral-Fiber, Preformed Pipe, Type I 1-1/2 inches (38mm) thick.
- C. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and Below: Insulation shall be the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
- D. Refrigerant Suction and Hot-Gas Piping: Insulation shall be one of the following:
 - 1. Flexible Elastomeric: 2 inches (50 mm) thick.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Piping, Exposed:
 - 1. Aluminum, Smooth 0.020 inch (0.51 mm) thick.

END OF SECTION

SECTION 23 11 23

INTERIOR NATURAL GAS PIPING

PART 1 - GENERAL

- 1.01 This system shall consist of all gas piping as indicated on the drawings to a point five feet outside building indicated including distribution and connection to every gas appliance furnished, installed or connected under this contract.
- 1.02 All work to comply with the requirements of the gas utility company, local codes, NFPA Pamphlet No. 54, and other sections of these specifications.

PART 2 - PRODUCTS

- 2.01 Pipe shall be Schedule 40 black steel assembled with malleable iron or welded fittings. Use welded fittings on 2" and above.
- 2.02 Pipe below grade shall be coated and wrapped. Straight lengths shall be furnished with factory-applied electrically insulating coating. Fittings and damaged coating shall be wrapped with Tapecoat CT applied in accordance with manufacturer's latest printed instructions. Install anodes per utility and code.
- 2.03 REGULATORS:
- A. Appliance regulators shall be equal to Rockwell Gas Appliance Regulator. Model and size as applicable for capacity as indicated on drawings.
 - B. Pounds-to-ounce regulators shall be equal to Rockwell Service Regulators with full capacity internal relief. Model and size as applicable for capacity indicated on drawings.

PART 3 - EXECUTION

3.01 INTERNAL PIPING:

- A. Provide a gas cock and appliance regulator at each gas-using appliance.
- B. Provide steel sleeves under all concrete floors. Vent end of sleeve with pipe equal in size to gas line sleeved and protect with cap. Sleeve shall be a minimum of two pipe sizes larger than pipe.
- C. Piping shall be run in ventilated spaces. Lay-in type ceiling will be considered ventilated. Where pipes run in hollow walls, vent cavity at top and bottom.
- D. Vent each pound-to-ounce regulator to the outside.
- E. Install anodes and cathodic protection accessories as required by utility and code.

F. Piping to be painted yellow per architect.

3.02 TEST: After completion of work, and before backfilling, if required, the entire system shall be tested to an air pressure of 125 PSI for a period of two hours and proved tight by inspection. Furnish results of the tests, signed by the Contractor, to the Engineer.

END OF SECTION 23 11 23

SECTION 23 23 00

REFRIGERANT PIPING

PART 1 - GENERAL

- 1.01 HVC piping systems shall consist of refrigerant piping handling fluorocarbons.
- 1.02 Do not vent refrigerants to the atmosphere. Install new systems using recovering methods. Evacuate and recover existing systems to be modified or removed.
- 1.03 Submit piping materials, fittings, and refrigeration accessories

PART 2 - PRODUCTS

2.01 REFRIGERANT PIPING:

- A. Pipe: "K" copper. Soft-drawn may be used where bending is required on 1-3/8" O.D. and smaller. All other shall be hard-drawn; or Type "L" Copper, hard-drawn, marked "ACR" at Contractor's Option.
- B. Fittings: Wrought copper or forged brass for refrigerant use.

PART 3 - EXECUTION

3.01 REFRIGERANT PIPING:

- A. To be installed by machine mechanics skilled in this type work, and in accordance with recognized industry standards.
- B. Make joints with "Sil-Fos" backed with nitrogen.
- C. Piping and specialties to be sized and installed as recommended by the manufacturer of refrigerant piping.
- D. Pre-charged lines may be used with approval of Engineer. These lines shall be installed as recommended by the unit manufacturer. Check charge after installation.
- E. See Section 23 07 00 for insulation.
- F. Isolate piping from building structure to prevent transmitting equipment vibration.
- G. See Section 23 05 29 for hangers.
- I. Installation:
 - 1. Minimum Requirements: Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly

capped until assembly. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.

2. Testing:

- a. General: Every refrigerant containing part of every system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively.
- b. Test Medium: Oxygen, or any combustible gas, or combustible mixture of gases shall not be used within the system for testing. The means used to build up the test pressure shall have either a pressure-limiting device or a pressure-relief device, and a gage on the outlet side. Set the pressure-relief device above the test pressure but low enough to prevent permanent deformation of the system components.
- c. System Test And Charging: Recommended by the equipment manufacturer or as follows:

- 1) Connect source or refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 10 psig. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.
- 2) Connect a source of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Refer to Table For Test Pressures. Test entire system again for leaks.
- 3) Operating Pressures, PSIG: From ANSI B9.1.

Refrigerant	Low Side	High Side
R-407C	150	230

- 4) Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gage reading in microns. Pull the system down to 100 microns and hold for four hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Duct liner insulation.

B. Related Sections:

1. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 1. Factory- and shop-fabricated ducts and fittings.
 2. Fittings.
 3. Penetrations through fire-rated and other partitions.
- C. Welding certificates.

1.04 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.01 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. McGill AirFlow LLC.
 - b. SEMCO Incorporated.
 - c. Sheet Metal Connectors, Inc.
 - d. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.03 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches

2.04 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width:[3 inches 976mm)].
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.

3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.05 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.06 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 2. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 4. Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel]; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.

- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.02 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 4. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 5. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 6. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 7. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 - 8. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 9. Conditioned Space, Return-Air Ducts: Seal Class C.

3.04 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.07 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

- B. Supply Ducts:

- 1. Ducts Connected to Fan Coil Units, and Terminal Units:

- a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.

- 2. Ducts Connected to Constant-Volume Air-Handling Units:

- a. Pressure Class: Positive 3-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.

- 3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

- a. Pressure Class: 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.

- C. Return Ducts:

- 1. Ducts Connected to Fan Coil Units, and Terminal Units:

- a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.

- 2. Ducts Connected to Air-Handling Units:

- a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
 - e.

- D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg (250 Pa).
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.

- E. Intermediate Reinforcement:
 1. Galvanized-Steel Ducts: Galvanized steel.
 2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 3. Aluminum Ducts: Aluminum.

- F. Liner
 1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
 2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
 3. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

- G. Elbow Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, [12 Inches] and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, [14 Inches] and Larger in Diameter: Standing seam.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Flange connectors.
6. Turning vanes.
7. Duct-mounted access doors.
8. Flexible connectors.
9. Flexible ducts.
10. Duct accessory hardware.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
 - e. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and maintenance data.

1.03 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: [G60].
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches

2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- 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. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Duro Dyne Inc.
 - 5. Greenheck Fan Corporation.
 - 6. NCA Manufacturing, Inc.
 - 7. Ruskin Company.
 - 8. SEMCO Incorporated.
 - 9. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity 3000 fpm
- D. Maximum System Pressure: 1-inch wg.
- E. Frame: 0.052-inch- thick, galvanized sheet steel.

- F. Blades: Multiple single-piece blades, pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Extruded vinyl, mechanically locked.
- I. Blade Axles:
 - 1. Material: Galvanized steel.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20-gage minimum.
 - b. Sleeve Length: 6 inches minimum.
 - 5. 90-degree stops.

2.03 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 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. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Ruskin Company.
 - g. Trox USA Inc.
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized steel channels, 0.064-inch minimum thickness.

- b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
- a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized -steel, 0.064 inch thick.
6. Blade Axles: Galvanized steel.
7. Bearings:
- a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
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. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Ruskin Company.
 - g. Trox USA Inc.
 2. Standard leakage rating.
 3. Suitable for horizontal or vertical applications.
 4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 6. Blade Axles: Galvanized steel.
 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Aluminum.

C. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.04 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Duro Dyne Inc.
4. Flexmaster U.S.A., Inc.
5. Greenheck Fan Corporation.
6. McGill AirFlow LLC.
7. METALAIRE, Inc.
8. NCA Manufacturing, Inc.
9. Ruskin Company.

B. Frames:

1. [Galvanized] steel channels, 0.064 inch thick.
2. Mitered and welded corners.

C. Blades:

1. Multiple blade with maximum blade width of 8 inches.
2. Parallel- and opposed -blade design.
3. Galvanized steel.
4. 0.064 inch thick.
5. Blade Edging: Closed-cell neoprene edging.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

D. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

- E. Bearings:
 - 1. Oil-impregnated bronze.
 - 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 3. Thrust bearings at each end of every blade.

2.05 FIRE DAMPERS

- 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. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. McGill AirFlow LLC.
 - 4. METALAIRE, Inc.
 - 5. NCA Manufacturing, Inc.
 - 6. Prefco; Perfect Air Control, Inc.
 - 7. Ruskin Company.
 - 8. Vent Products Company, Inc.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to [4-inch wg] static pressure class and minimum [4000-fpm] velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
 - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, [165 deg F] rated, fusible links.

2.06 FLANGE CONNECTORS

- 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. Ductmate Industries, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.07 TURNING VANES

- 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. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vaness and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Double wall.
- E. Vane Construction: Single wall for ducts up to [48 inches] wide and double wall for larger dimensions.

2.08 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Ductmate Industries, Inc.
 - 3. Flexmaster U.S.A., Inc.
 - 4. Greenheck Fan Corporation.
 - 5. McGill AirFlow LLC.
 - 6. Ventfabrics, Inc.

- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
- C. Pressure Relief Access Door:
 - 1. Door and Frame Material: Galvanized sheet steel.
 - 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
 - 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
 - 4. Factory set at pressure to be determined by Engineer.
 - 5. Doors close when pressures are within set-point range.
 - 6. Hinge: Continuous piano.
 - 7. Latches: Cam.
 - 8. Seal: Neoprene or foam rubber.
 - 9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.09 FLEXIBLE CONNECTORS

- 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. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip [3-1/2 inches] wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

2.10 FLEXIBLE DUCTS

- 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. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.
- C. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 20 to plus 175 deg F.
 4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1.
- D. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
 2. Non-Clamp Connectors: Liquid adhesive plus tape.

2.11 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft or control dampers as shown at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. Adjacent to and close enough to fire , to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 2. Control devices requiring inspection.
 - 3. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.

- K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Connect terminal units to supply ducts with maximum [12-inch] lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect flexible ducts to metal ducts with liquid adhesive plus tape.
- O. Install duct test holes where required for testing and balancing purposes.

3.02 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Operate fire to verify full range of movement and verify that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation.

END OF SECTION

SECTION 23 74 00
PACKAGED OUTDOOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Packaged rooftop units and commercial packaged gas/electric

1.2 REFERENCES

- A. Safety Standards:
 - 1. Underwriters Laboratories (UL).
 - 2. Underwriters Laboratories of Canada (ULC).
 - 3. National Electric Code (NEC).
 - 4. Canadian Electric Code (CEC).
- B. Air-Conditioning, Heating and Refrigeration Institute (AHRI):
 - 1. AHRI 340/360 Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
 - 2. AHRI 370 Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.
 - 3. AHRI 210/240 Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment.
- C. All models are ASHRAE 90. 1-2007 compliant
- D. ISO 9001, Manufacturing Quality Systems

1.3 PERFORMANCE REQUIREMENTS

- A. Capacity as Scheduled
- B. Electrical Characteristics as scheduled

1.4 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures
- B. Product Data: Submit product data for specified products
- C. Shop Drawings:
 - 1. Submit shop drawings in accordance with Section [01 33 00 - Submittal Procedures]
 - 2. Indicate:
 - a. Equipment, piping and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections
 - b. Piping, valves and fittings shipped loose showing final location in assembly
 - c. Control equipment shipped loose, showing final location in assembly
 - d. Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details,

- D. Storage and Protection:
 - 1. Store materials protected from exposure to harmful weather conditions
 - 2. Factory shipping covers to remain in place until installation

1.7 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
- C. Warranty Bond: Commencing on Date of Installation
 - 1. Limited 10 years Aluminized Heat Exchanger
 - 2. Limited 5 years on compressors
 - 3. Limited 5 years on High Performance Economizers
 - 4. Limited 1 year all other covered components

PART 2 - PRODUCTS

2.1 PACKAGED ROOFTOP UNITS

- A. Manufacturer:
 - 1. Lennox Industries
 - 2. Trane
- B. General:
 - 1. Capacity
 - a. 3-6, 7.5-12.5, 13-25 tonnages
- C. Proprietary Products/Systems:
 - 1. Cabinet:
 - a. Heavy gauge steel panels
 - b. Pre-painted steel panels
 - c. Full perimeter heavy gauge galvanized steel base rail
 - d. Rigging holes on all four corners
 - e. Forklift slots (on three sides, not directly below condenser coil) on base rail
 - f. Raised or flanged edges around duct and power entry openings
 - g. Airflow Choice:
 - 1. 2 to 12.5 ton units are shipped in downflow, configuration can be field converted to horizontal air flow with optional Horizontal Discharge Kit
 - h. Electrical lines and gas lines can be brought through the base (optional feature) of the unit or through horizontal knockouts
 - i. Insulation:

1. All panels adjacent to conditioned air are fully insulated with non-hygroscopic fiberglass insulation
2. Unit base is fully insulated
3. Unit base insulation also serves as air seal to the roof curb
- j. Access Panels: Hinged for compressor/controls/heating areas, blower access and air filter/economizer access; and, sealed with quarter-turn latching handles and tight air and water seal
- k. Exterior panels constructed of heavy-gauge galvanized steel with two layer enamel paint finish
- l. Corrosion resistant double sloped condensate Drain Pan
- m. Service Valves
2. Cooling System:
 - a. Refrigerant type: R-410A
 - b. Capable of operating from 30 to 125° F (-1 to 52° C) without installation of additional controls
 - c. Compressors:
 1. Scroll Type
 2. Resiliently mounted on rubber mounts for vibration isolation
 3. Overload Protected
 4. Internal excessive current and temperature protection
 5. Isolated from condenser and evaporator fan air streams
 6. Refrigerant cooled
 - d. Thermal Expansion Valve
 - e. High capacity filter/driers
 - f. High pressure switches
 - g. Crankcase heaters
 - h. Freezestats
3. Coil Construction:
 - a. Tube and fin condensing/evaporator coil general construction:
 1. Aluminum Rippled and Lanced fins
 2. Copper tube construction
 3. Aluminum fins mechanically bonded to copper tubes
 4. All coils are high pressure leak tested at manufacturing facility
 - b. Environ condensing coil general construction:
 1. Aluminum/Aluminum construction
 2. Aluminum Lanced fins
 3. Aluminum fins thermally bonded to aluminum flat tube
 4. All coils are high pressure leak tested at manufacturing facility
 - c. Evaporator Coils:
 1. With balanced port thermal expansion valves, freeze protection on each

- compressor circuit, pressure and leak tested to 500 psi
- 2. Each compressor circuit on coil divided by rows that are active across the entire surface area of the supply air on all models
- d. Condenser Coils:
 - 1. Flexible immersed coating electrodeposited by dry film process on corrosion hardened units only
- e. Condensate Drain Pan:
 - 1. Side or bottom drain connections
- f. Outdoor coil fan motors:
 - 1. Thermal overload protected
 - 2. Shaft up, wire basket mount
 - 3. Permanently lubricated Sleeve/Ball bearings
- g. Outdoor coil fans: PVC coated fan guard furnished
- h. Drain Pan Overflow Switch
- i. Low Ambient Kit
- 4. Wiring:
 - a. Keyed and labeled field connections, color coded and continuously marked wire to identify point-to-point component connections
 - b. Not in contact with hot-gas refrigerant lines or sharp metal edges
- 5. Gas Heating System:
 - a. Induced draft
 - b. Natural gas fired system with direct spark ignition
 - c. Electronic flame sensors
 - d. Flame rollout switches
 - e. High heat limit switches
 - f. Induced draft failure switch and capable of operating to altitude of 2000 feet (610 m) with no derate to manifold pressure
 - g. Service access for controls, burners and heat exchanger
 - h. Heat Exchanger:
 - 1. Tubular Design
 - 2. Stainless steel
 - i. Gas piping system tight and free of leaks when pressurized to maximum supply pressure
 - j. Gas Valve: Single Stage
 - k. Gas Burners: Aluminized steel inshot-type gas burners
 - l. Direct spark pilot ignition
 - m. Fan and Limit Control
 - n. Safety Switches
 - o. Gas piping system tight and free of leaks

6. Supply Air Fan (Blower):
 - a. Motor
 1. Overload protected
 2. Equipped with ball bearings (belt drive) or sleeve bearings (direct drive)
 - b. Supply Air Blower
 1. Forward curved blades
 2. Wheel is statically and dynamically balanced
 3. Equipped with ball bearings and/or adjustable pulley for speed change
 4. Blower assembly slides out of unit for servicing
7. Supply Air Filters:
 - a. 2" MERV 8 Filters
8. Controls:
 - a. Unit Control
 1. 24V transformer (secondary) with built in circuit breaker protection
 - b. Heat/Cooling Staging
 1. 1 heat/1 cooling staging thermostat
 - c. Low voltage terminal block
 - d. Night setback mode
 - e. Controls Options:
 1. Thermostat

2.2 PRODUCT SUBSTITUTIONS

- A. Substitutions: Substitutions permitted upon approval of the Engineer

PART 3 – EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions and manufacturer's SPEC-DATA® sheets.

3.2 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. Install packaged rooftop units in accordance with manufacturer's instructions. On roof curbs provided by manufacturer as indicated.

END OF SECTION

SECTION 26 00 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic electrical requirements specifically applicable to Divisions 26, 27, 28 sections in addition to applicable Division 01 sections of the Specifications. The Engineer (or Architect) shall herein be the A/E.

1.2 COORDINATION

- A. The electrical work shall be installed in cooperation with other trades installing inter-related work. Coordinate all conduit runs to miss mechanical ducts as shown on mechanical sheets and at building.
- B. Anchor bolts, sleeves, inserts, and supports shall be installed by this subcontractor.
- C. Contact Engineer three days prior to pouring of slabs to verify floor outlet locations. Obtain dimensioned drawings from the Architect for floor outlet positioning.

1.3 SUBMITTALS

- A. Deviation from the Drawings and Specifications shall be called to the attention of the Architect in writing at the time of submission of the Shop Drawings. The Engineer's checking of any drawing shall not release the subcontractor from responsibility for such deviations.
- B. The Contractor shall furnish complete sets of certified Shop Drawings. Provide submittals for Lighting, Switchgear, electronic systems, wiring devices and other items as noted in other sections of the specification.
- C. Where equipment requiring different arrangement of connections from those shown is approved, it shall be the responsibility of the subcontractor to install the equipment to operate properly and in harmony with the intent of the Contract Documents, and to make all changes in the work required by the different arrangement of connections and pay all charges resulting from changes.
- D. Submittals shall include physical dimensions of electrical equipment.

1.4 CODES, ORDINANCES, INSPECTIONS AND PERMITS

- A. Obtain and pay for required fees, permits, and inspections for electrical work.
- B. Perform Work in accordance with N.E.C., N.F.P.A., U.L., local codes and N.E.C.A. (latest version).

1.5 DELIVERY, STORAGE AND HANDLING

- A. Place stored materials on clean, hard surfaces above ground and keep covered at all times to ensure protection from paint, plaster, dust, water and other construction debris or operations.
- B. Keep conduit ends plugged or capped, and all covers closed on boxes, panels, switches, fixtures, etc., until installation of each item.
- C. Stored materials and equipment shall be located to facilitate prompt inspection.

1.6 ACCURACY OF DATA

- A. The data given herein and on the Drawings are as exact as could be secured, but their absolute accuracy is not guaranteed. Exact locations, distances, levels, etc., will be governed by the building, and the Contractor shall use the data contained herein with this understanding.
- B. The Contractor shall verify all measurements at the building and shall be responsible for the correctness of same. No extra compensation will be allowed because of differences between work on the Drawings and measurements of the building.

1.7 INTENT OF DRAWINGS AND SPECIFICATIONS

- A. The intent of the Electrical Drawings and Specifications is that the subcontractor shall furnish all labor and materials, equipment and transportation necessary for the proper execution of the work. This subcontractor shall thoroughly examine the Drawings and Specifications relating to other trades in order to include all necessary work in his bid. No additional payments shall be considered for failure to properly interpret the responsibilities to other trades. The subcontractor shall do all the work shown on the Drawings and described in the Specifications and all incidental work necessary to complete the Project in a substantial and acceptable manner, and to fully complete the work ready for use, occupancy, and operation by the Owner. The A/E reserves the right to make any reasonable changes up to six feet (6') in the locations indicated without additional cost to Owner.

1.8 OPERATING AND MAINTENANCE MANUALS

- A. Deliver to the A/E for the Owner's use, two complete operating and maintenance manuals covering all equipment and systems installed by this Division.
- B. Include approved equipment and material submittals, parts lists, wiring diagrams, and operating instructions for all operating equipment.
- C. Bind brochures in hard back three ring binder and tab indexed. Label front cover and back spine indicating project name. Include page showing data and local responsible vendors with addresses and telephone numbers and furnishing parts and information on equipment.

1.9 OBSERVATION OF WORK

- A. The A/E will make final onsite review of the Work of this division, prepare punch list, and visit the job site to check the punch list.
- B. If additional trips are required to the job because the Contractor did not perform the work as shown and called for on the punch list, then the Contractor shall reimburse the A/E for charges at the rate of \$175.00 per hour plus 55 cents per mile for travel expenses.
- C. The Contractor shall allow the Engineer access to all parts of the Work and shall furnish assistance and information as required by the Engineer.

1.10 PROJECT RECORD DRAWINGS

- A. The Contractor shall provide as-built drawings. Record all deviations from plans, actual locations of underground utilities etc.

1.11 INSPECTION OF SITES

- A. Inspect the site and become thoroughly familiar with conditions to be met and the work to be accomplished. At existing building sites verify prior to bid all conditions shown affecting work.

1.12 SAFETY AND WORK METHODS

- A. Refer to General Conditions.
- B. The Electrical Subcontractor is completely responsible for how all of his work is performed; safety, in, on, or about the job site; methods of performance;

and timeliness in such performance. In the event he is unsatisfied with the performance of other trades, he shall set forth such complaints in writing for the Owner's review. In no event shall this subcontractor expect to be specifically directed in the protection of personnel or material by the Owner, Architect, or Engineer.

1.13 NOISE AND VIBRATION CONTROL

- A. Isolate noise generating equipment and all equipment mounted to building including A/C units, ballast, etc., with flexible conduit to prevent transmission of noise through conduit system.

1.14 PAINTING

- A. Repair finish surfaces damaged by Work of this section.
- B. Paint equipment and material furnished and installed under this section that has only a prime coat of paint. Use color and brand of paint selected by Architect.
- C. All "exposed to view" conduit, boxes, panels, etc. to be primed and painted with color selected by Architect. Verify prior to painting.

1.15 TEMPORARY CONSTRUCTION POWER

- A. This Contractor shall furnish and install temporary construction power wiring as required. Temporary electrical service shall be obtained in the name of the General Contractor, and it will be the General Contractor's responsibility to pay all power company charges. The temporary service shall be obtained from the local utility company. Provide temporary lighting as required for adequate illumination for construction and safety purpose.

1.16 LICENSING REQUIREMENT

- A. No person shall perform electrical work on the contract without possessing an Arkansas State Master or Journeyman License from the Arkansas State Electrical Examiners Board. All electrical work and apprentice electricians shall be supervised as required by State law.
- B. All electricians shall have a copy of their license with them and shall be required to show it to an appropriate inspector upon request.

1.17 SPECIAL INSPECTIONS

- A. Refer to architectural documents regarding special inspections. Regarding electrical components special inspections shall include light fixtures and the generator at completion of construction and periodically.

PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT

- A. In order to establish standards of quality, the Engineer has referred to certain products by name and catalog number. This procedure is not to construed as eliminating from competition other products of equivalent or better design. Where multiple manufacturing sources are shown on the Drawings or herein specified, the subcontractor shall limit his bid to one of those manufacturers.
- B. Electrical fixtures, appliances, hardware, switch gear, panel boards, boxes and other items related in any manner to electrical work shall be considered; however, it will be at the discretion of the Architect and the electrical engineer to evaluate "equal" as a substitution to that as specified. It will be the responsibility of the bidder for the substituted item's approval. Should item be deemed "not equal" by the Architect and electrical engineer, then the bidder must supply the item as specified without additional cost to the Owner or any design team member.
- C. The subcontractor shall abide by the Engineer's judgment when proposed substitute materials or items of equipment are judged to be unacceptable and shall furnish the specified material or item of equipment in such case. All proposals for substitution shall be submitted in writing by the General Contractor and not by the Electrical Subcontractor or material suppliers. The Engineer will approve or disapprove proposed substitutions in writing. If any request for a substitution is rejected, the Contractor shall automatically furnish material specified. All materials shall be new and shall bear the manufacturer's name and the Underwriters Laboratory label. Materials of the same general type shall be the same throughout the job to provide uniform appearance, operation, and maintenance.
- D. Delivery and Storage: Equipment and materials shall be delivered to the site and stored in original containers. All items subject to moisture damage (such as coils of dry transformers) shall be stored in dry, heated space. At the completion of the work, fixtures, equipment, and materials shall be cleaned and polished thoroughly and turned over to the Owner in a condition satisfactory to the Architect. Damage or defects developing before acceptance of the work shall be made good at no expense to the Owner.

2.2 LABELING

- A. Each major component of equipment shall have a nameplate listing the manufacturer's name, address, catalog and serial number. The nameplate shall be brass, aluminum or other durable material attached to the equipment in a conspicuous location. Nonferrous identifying tags or pressure-sensitive labels shall be provided for all cables, feeders, and power circuits in vaults, pull boxes, manholes and switchboard rooms at cable termination and in other locations.
- B. Tags or labels shall be stamped or printed to correspond with markings on the as-built drawings so that feeder or cable may be readily identified. Electrical equipment, safety switches, time clock, starters, panels and transformers shall have black and white laminated bakelite nameplates securely fastened to device with screws and be exposed. Edge of plates shall be beveled. Letters shall be white with black field. Letters shall be 3/8-inch upper case. Nameplate shall state its purpose and the voltage of the equipment. 120 or 240 volt equipment shall have black; 480 volts red.
- C. Provide "Flash Protection" label as per NEC.

2.3 FLASHING

- A. For roof penetrations, furnish penetration as approved by roofing company.

2.4 ACCESS PANELS

- A. Furnish access panels as required to service electrical devices.
- B. Furnish size and type as required for proper service or as shown on Drawings for specific locations.

2.5 WIRING NOT IN RACEWAY

- A. Where the Drawings or Specifications allow communication system wiring to be run without raceways, the Contractor shall supply plenum-rated wire where wiring penetrates air plenums, whether indicated or not.

2.6 ARRESTORS

- A. Where a data, telephone, fire alarm, intercom or similar cable is specified for the project; provide arrestors at all cable entrances as per code.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

- A. Provide cutting and patching required to perform the electrical work. Do not cut structural members except through explicit instructions of the Architect/Engineer. Accomplish patching with workmen skilled in the trade required. Perform cutting and fitting in rough construction phases of the work.

3.2 FIRE STOPPING

- A. When wiring or conduit penetrates a rated wall this contractor shall provide a fire rated sealant or system equal or great than the fire rating of the wall. This includes sealing sleeves that are used for low voltage cables. Seal after cable installation. This includes cables installed by owner if installed prior to completion of the project. If the owner has not installed cables by end of project provide proper capping methods.

3.3 ACCESSIBILITY

- A. Install in an accessible location, all junction boxes, starters, relays, light fixtures, and other items that may require servicing or repairing.

3.4 CLEARANCES

- A. Maintain clearances in front of electrical equipment as required by code. Report discrepancies to A/E PRIOR TO ROUGH-IN.

- B. Submit ½" = 1'-0" scale plan showing layout of electrical equipment.

3.5 EXCAVATING, TRENCHING, AND BACKFILLING

- A. Excavate and trench as required to install portion of the electrical systems required to be located below grade. Arrange cutting of streets and walks with governing authorities and patch cuts to conform to their requirements.

- B. Protect roots of trees designated to remain. Perform trenching within the branch spread by hand. When trench is opened, install the utility immediately, prune injured roots cleanly, and backfill as soon as possible.
- C. Keep trenches free from water while construction therein is in progress. Conduct discharge from dewatering to drains or natural drainage channels.
- D. Backfill trenches only after required electrical system tests have been completed. Backfill and tamp in 6-inch layers with materials free of large stones or clods of earth to cover of 12 inches. Backfill the remainder of trenches in 12-inch layers. Do not use blasted rock, broken concrete or large boulders for backfill. Backfill entire depth of trenches to be covered with roads, walks, or concrete slabs in 6 inch layers, compacting each layer to 95 percent of maximum dry density at or near optimum moisture content as determined by Standard Proctor procedures, ASTM D698.
- E. Ensure that buried lines have a minimum of 30-inch cover. Install marking tape above all feeder conduits ,telephone and data lines. Do not install utility lines beyond 2 feet from the building until rough grading is completed. Allow for finished grading operations to ensure adequate final cover over lines.

3.6 WIRING

- A. Electrical wiring for mechanical equipment or equipment furnished by others is separated into two main wiring divisions: (1) Power wiring by Electrical Contractor and (2) Control wiring by Mechanical Contractor.
- B. Power wiring shall be the energy source and shall include installation of circuit protective devices, controller, conduit, wiring, and safety disconnects from power supply, and terminating at the motor or appropriate terminals on equipment. Install starters as required.
- C. Control wiring shall comprise conduit and wiring not included in power wiring or noted above. This wiring shall include low voltage automatic temperature control wiring, safety and interlocking wiring, push button starting, pilot light, and signal wiring, etc., that is not included as part of safety equipment.
- D. The Electrical Contractor shall install all wiring and equipment specifically shown on the Electrical Drawings.
- E. All telephone, data and similar wiring shall be permanently marked. In addition a wiring schedule shall be placed on the as-builts.

3.7 CONNECTION OF EQUIPMENT NOT SPECIFIED IN THIS DIVISION

- A. Provide necessary materials and make connections to equipment requiring electrical power.
- B. Rough-in for connection of this equipment according to shop drawings furnished with the equipment or by actual measurements taken from equipment on site. Provide junction boxes, disconnect switches, etc., required to properly connect each piece of equipment unless specifically stated otherwise.

3.8 UTILITIES LOCATIONS, METERS, AND CONNECTIONS

- A. Arrange with proper authorities and utility companies for service connections, verifying locations and arrangements. Pay all costs of service as shown and provide all required conduits, meter bases wiring for indicated service. Contact the serving utility prior to bid and include all cost of utility services in bid.
- B. When connections to existing lines, rerouting of utility lines, modifications to services, etc., would interrupt service or interfere with normal use of the buildings, arrange work such that outages are minimized and schedule outages to occur at times satisfactory to the Owner.
- C. Before ordering equipment and proceeding with Work, verify with the utility company existing or available voltages shown on Drawings. If voltage differs from that noted on the Drawings and in the Specifications; notify the Engineer immediately.
- D. Transformers: Locate utility transformer pads so as to provide code (and Utility) required clearances from building. Verify prior to bid.

3.9 APPEARANCE OF WORK

- A. Arrange and install exposed portions on Work specified under this division such as devices, fixtures, panels, and safety switches to fit in and harmonize with Work specified in other divisions.
- B. Run conduits concealed in chases, attics or cable trenches unless indicated otherwise. Run conduit exposed to view in mechanical rooms and electrical equipment rooms.
- C. Run conduit parallel or perpendicular to building lines.

3.10 TESTS

- A. Test panel feeders, motor circuits, and conductors larger than #6 with a 600 volt Megger to prove insulation resistances.
- B. Test grounding electrode system to verify compliance with N.E.C. requirements.
- C. Demonstrate in the presence of the Engineer testing of the emergency power system, the interface between the fire alarm and sprinkler system, the interface between the fire alarm and HVAC control systems and the interface between the fire alarm and elevator controls if such systems are on the project.

3.11 GUARANTY PERIOD

- A. Electrical Contractor shall warrant equipment furnished and work performed for a period of one year from date of written acceptance of work. This guarantee shall cover patching, refinishing, etc., required to restore faulty condition at no additional expense to Owner.

3.12 CLEANING

- A. At completion of work, clean and polish fixtures, equipment, and materials.

3.13 CONFLICT

- A. If there is a conflict between Drawings and Specifications, provisions of the most stringent shall control. Drawings and Specifications are complementary; work required by one, but not required by the other, shall be performed as though required by both.

3.14 MOTOR CONNECTIONS

- A. Wherever equipment requiring electrical connection is specified, power wiring shall be furnished and installed under applicable sections of Electrical Division of Specifications. Starting switches, protective devices, and other means for operation and control of equipment shall be furnished under applicable equipment sections but shall be installed under applicable electrical section, unless specifically noted otherwise on Drawings. Additional disconnects required by National Electrical Code shall be furnished, installed, and connected by Electrical Contractor. Motor terminals

or equipment connections shall terminate in a junction box or disconnect adjacent to equipment. See Mechanical Plan for exact location of motors.

- B. Install conduit and boxes for thermostats. Obtain count and location from mechanical Drawings. Extend conduit from thermostat box to equipment. If thermostat conduits are shown to be included under the mechanical section then that section shall take precedence.

END OF SECTION

PRE-FINAL PROJECT OBSERVATION CHECK LIST

Complete this form and forward to the Engineer's office three business days prior to the requested Final Project Observation date.

Forward this form to: Lucas, Merriott & Associates
 2225 West Seventh Street
 Little Rock, Arkansas 72201
 Phone: 501.374.3522
 FAX: 501.375.7505

	ITEM	YES	NO
1.	Polarity of all receptacles shall be tested. GFI receptacles shall be tested. *		
2.	Test all emergency lighting by turning circuit breakers off.		
3.	Provide typed panel directories.		
4.	Obtain certification letter from Fire Alarm Vendor indicating the system has been tested and is fully operational.		
5.	Clean fixture lenses and reflectors.		
6.	Provide Owner with spare lamps, parts, keys, etc. as specified for this project.		
7.	All junction boxes shall have covers and shall be labeled with the circuit number(s).		
8.	Clean all switchgear and provide designation label.		
9.	Remove paint from all devices and device plates.		
10.	Replace all burned out lamps.		
11.	Megger test reports (attach with this form)		
12.	Ground and bonding connections to cold water pipe, building steel, ground rods, etc.		

*test with ECOS #1019 or similar tester

All of the items must be met prior to the Final Project Observation.

Requested Final Project Observation date: _____

Signature of Electrical Contractor: _____

SECTION 26 05 19

WIRE AND CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building wire and cable.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Feeders and branch circuits larger than 10 AWG: stranded conductor, 600 volt insulation, THW or THHN/THWN. Conduit sizes are based on THWN. Wiring shall have UL listing and markings on insulation. Use THHN where fluorescent fixture channel is used as wireway. Wire sizes shown are based upon copper conductors unless noted as "AL".
- B. Stabiloy may be used for feeders and services that exceed 800 amps. Adjust wire size to match copper rating. Aluminum is not permitted except as noted here or specifically on the plans.
- C. Feeders and branch circuits 10 AWG and smaller: Solid conductor, 600 volt insulation THHN/THWN.

2.2 COMMUNICATION SYSTEM WIRING

- A. Wiring type and size for communication (nurse call, intercom, bell systems) and fire alarm systems shall be as recommended by equipment manufacturer. In no case shall any circuit carrying a load have less more than 3% voltage drop. Contractor shall check Drawings and provide plenum-rated wiring where wiring penetrates air plenums and is allowed by the Drawings or Specifications to not be run in raceway.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

- A. Use no wire smaller than 12 AWG for power and lighting circuits, no smaller than 14 AWG for control wiring other than that listed above. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs

longer than 75 feet and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet. For longer runs consult Engineer for required sizes.

- B. **EACH CIRCUIT SHALL HAVE A SEPARATE NEUTRAL (NO SHARING).**
- C. For parallel feeders; place an equal number of conductors for each phase of a circuit in same raceway or cable and make conductor lengths the same.

3.2 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires. Completely and thoroughly swab raceway system before installing conductors.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

3.3 COLOR CODING

- A. Color code wiring as per code.

3.4 CIRCUITING

- A. **Circuit as shown on Drawings.** Failure to properly circuit according to Drawings shall result in rewiring as directed at no increase in Contract Sum. Contact Engineer for resolutions of circuiting conflicts. If duplicate circuit numbers are found on the plans contact the Engineer prior to rough in. Allow for spare room in all conduits by not filling to more than 60% of that allowed by NEC.

END OF SECTION

SECTION 26 05 26

SECONDARY GROUNDING

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

- A. Ground the electrical service system neutral at service entrance equipment to metallic water service where applicable and to supplementary grounding electrodes.
- B. Ground each separately-derived system neutral to nearest effectively grounded metallic water pipe where applicable or nearest effectively grounded building structural steel member.
- C. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and piping systems.
- D. Do not connect neutral and ground anywhere except at service entrance.
- E. Do not use conduit as the sole grounding method.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Ground Rods: Copper-encased steel, 3/4-inch diameter, minimum length 10 feet.
- B. Furnish BURNDY bar connectors or CADWELD connectors.
- C. Provide a concrete encased grounding electrode for the main grounding electrode

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide a separate, insulated equipment grounding conductor in feeder and branch circuits. Terminate each end on a grounding lug, bus, or bushing.
- B. Connect grounding electrode conductors to metal 1-inch water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.
- C. Supplementary Grounding Electrode: Use driven ground rod on exterior of building. Connect grounding system to nearest structural steel member.
- D. Provide a #6 AWG minimum copper conductor for communications service grounding conductor. Leave 10 feet slack conductor at telephone terminal board. Provide grounding as directed in Telecommunications section if included.
- E. Isolated Grounding Systems: Use insulated equipment grounding conductor and connect only at panel ground bus. Use isolated ground receptacles.

3.2 FIELD QUALITY CONTROL

- A. Leave grounding points exposed for inspection – Provide box with cover for inspection port.

END OF SECTION

SECTION 26 05 33a

CONDUIT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Raceways

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND FITTINGS

- A. Allied, Triangle or approved equal.
- B. Quick connect type rigid steel couplings not permitted.

2.2 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: FS WW-C-566; steel or aluminum.
- B. Fittings and Conduit Bodies: Use clamp or compression type ANSI/NEMA FB 1. Screw in type not allowed.

2.3 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

- A. Conduit: Flexible metal conduit with PVC jacket.
- B. Fittings and Conduit Bodies: Use compression type connectors; screw in type not allowed. ANSI/NEMA FB 1.

2.4 PLASTIC CONDUIT AND FITTINGS

- A. Conduit: Carlon or equal.

2.5 ARMORED CABLE – Not permitted.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. Size conduit for conductor type installed, minimum size 3/4-inch. Conduit sizes shown on Drawings are based on THWN. Provide spare capacity in all branch circuits by not filling to more than 60% of the NEC allowed conduit fill.
- B. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers. Arrange conduit to maintain headroom and present a neat appearance.
- C. Group conduit in parallel runs where practical.
- D. Do not fasten conduit with wire or perforated pipe straps or piggy back type clamps. Remove all wire used for temporary conduit support during construction before conductors are pulled.
- E. Conduit and conduit bodies including, FS & FD or larger cast or sheet metal boxes, are not permitted to be supported by either a ceiling grid wire and/or the ceiling grid itself, via any conduit or conduit body clips which may include but would not be limited to: t-bar and/or ceiling wire conduit clips.

3.2 CONDUIT INSTALLATION

- A. Cut conduit square using saw; de-burr cut ends and bring conduit to the shoulder of fittings and couplings and fasten securely.
- B. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.
- C. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inch size.
- D. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- E. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- F. Provide pull strings in all empty conduits.
- G. Install expansion joints where conduit crosses building expansion joints and every 75 feet.

- H. Where conduit penetrates fire-rated walls and floors, provide fire-stop fittings with UL listed fire rating equal to wall or floor rating.
- I. Install four spare 3/4-inch conduits from each flush mounted power panel to an accessible point above ceiling and cap off.
- J. Use long radius elbows on telephone conduit over 1-inch size.
- K. Where installed on top of a roof do NOT use wood supports. Provide a UV protected high density polypropylene base UL listed for the purpose. Use a section of roof membrane below the support to protect the roof. Use stainless steel vertical supports and unistrut to create a trapeze. Use a galvanized roller hanger or band for the pipe. Optionally use Cooper Industries "Dura-Blok" systems with a protective membrane between the roof and the blocks.

3.3 CONDUIT INSTALLATION SCHEDULE

- A. Galvanized rigid steel: Minimum 3/4-inch size may be used in all areas.
- B. Electrical Metallic Tubing: Minimum 3/4-inch size may be used in indoor dry locations where it is:
 - 1. Not subject to damage, not in contact with earth, not in concrete slabs on grade and in compliance with other qualifications in this section.
- C. Schedule 40 PVC may be run for underground branch circuits and feeders.
- D. Flexible steel conduit: 1/2-inch minimum; use for final connection to recessed fluorescent light fixtures and mechanical equipment; length not to exceed four feet. Support independently of the box.
- E. Liquid-tight flexible steel conduit:
 - 1. Use for outdoor final connections to mechanical equipment, length not to exceed four feet.

END OF SECTION

SECTION 26 05 33b

BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pull, junction, and outlet boxes.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, with 1/2-inch male fixture studs where required. Use 4x4 deep type box with single gang mud ring for telephone and data outlets.
- B. Cast Boxes: Cast ferrous alloy, deep type, gasketed cover, threaded hubs.

2.2 FLOOR BOXES AND WALL BOXES

- A. On grade floor boxes shall be Wiremold Evolution Series EFB45S-OG multiservice box unless noted otherwise. Provide a complete assembly matching box to floor type and trip to floor covering type. Include all internal components for wiring to be installed. Unless noted otherwise include ports for data, HDMI, duplex receptacle and telephone.
- B. Provide Wiremold: EFSB4 for wall mounted TV's and for connections to Lecturn. Include cover in bid price unless noted otherwise. Each box shall have a duplex receptacle, data port, HDMI and coax. Where used as a lecturn box extend a 2" conduit to above ceiling for low voltage cables.
- C. For boxes on floors above ground level where the slab does not permit the box noted above use the Wiremold Evolution Series Poke through multi service box. Unless stated otherwise bid the 6" as a minimum but insure it is large enough for all requirements indicated on the plans.
- D. Obtain exact mounting location for these boxes from Architect.

2.3 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.

- B. Cast Metal Boxes for Outdoor and Wet Locations Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- C. Cast Metal Boxes for Underground Installations: NEMA 250; Type r, outside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.

PART 3 - EXECUTION

3.1 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance. Electrical box locations shown on Drawings are approximate unless dimensioned.
- B. Mount switches and pull stations 48 in (center of box) above finish floor and receptacles 16 inches (center of box) above finish floor. Mount clock outlets 12 inches below ceiling. Strobes 80" AFF.
- C. Refer to architectural plans prior to rough in. Coordinate the architectural plans with that shown on the electrical plans. If there are discrepancies, obtain correct rough in locations prior to work. Verify with the architect the exact locations of all wall mounted devices. If this is not done the contractor shall move them as directed by the architect for no additional cost. In general light switches shall always be located near the door strike side jam unless there are sidelight. Where there are sidelights – confirm the location.

3.2 OUTLET BOX INSTALLATION

- A. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24-inch separation in acoustic and fire rated walls. Separate phone/data and power by 12 inches.
- B. Provide knockout closures for unused openings.
- C. Support boxes independently of conduit except for cast boxes that is connected to two rigid metal conduits, both supported within 12 inches of box.

- D. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- E. Install outlets mounted above counters, benches, and backsplashes according to millwork plans.
- F. Position lighting outlets as per reflected ceiling plans.
- G. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening. NO boxes shall be installed in inaccessible areas.
- H. Secure boxes to interior wall and partition studs with 8-32 bolts or weld. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- I. Align wall-mounted outlet boxes for switches, thermostats, and similar devices. Set switch boxes within 6 inches of door jamb where applicable.
- J. Provide cast outlet boxes in exterior locations exposed to the weather and wet locations.

3.3 FLOOR BOX INSTALLATION

- A. Set boxes level and flush with finish flooring material. Install floor boxes as directed by Arch. **Obtain exact dimensions from Architect prior to rough in.**

END OF SECTION

SECTION 26 05 48
SEISMIC PROTECTION

PART 1 - GENERAL

1.1 GENERAL

A. The requirements for seismic protection measures to be applied to electrical equipment and systems specified herein are in addition to any other items called for in other sections of these specifications. Electrical equipment shall include the following items to the extent required on plans or in other sections of these specifications:

1. Light fixtures
2. Switchgear

1.2 CONDUIT NOT REQUIRING SPECIAL SEISMIC RESTRAINTS

- A. Seismic restraints may be omitted from the following installations:
- B. All electrical conduit less than 2 1/2" inside diameter
- C. All conduit suspended by individual hangers 12" or less in length from the top of pipe to the bottom of the support for the hanger.

1.3 SHOP DRAWINGS

A. Shop drawings along with catalog cuts, template, and erection and installation details, as appropriate, for the items listed below shall be submitted. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

PART 2 - PRODUCTS

2.1 BOLTS AND NUTS

A. Squarehead bolts and heavy hexagon nuts: ANSI B1 8.2.1 and B1 8.2.2, and ASTM A307 or A576.

- B. Bolts, underground: ASTM A325

2.2 SWAY BRACE

- A. Materials used for member listed in Table I of this specification shall be structural steel conforming with ASTM A36.

PART 3 - EXECUTION

3.1 SWAY BRACE

- A. Sway brace shall be installed on conduit not otherwise rigidly anchored to preclude damage during seismic activity. Bracing shall conform to approved arrangements. Provisions of this paragraph apply to all conduit within a 5'-0" line around outside of building unless buried in the ground. Hanger rods shall be increased in cross sectional area proportionate to the increased weight per linear foot of pipe and contents supported at each trapeze hanger. No trapeze-type hanger shall be secured with less than two 1/2" bolts.
- B. TRANSVERSE SWAY BRACING: Transverse sway bracing shall be provided at intervals NOT TO EXCEED 30'-0".
- C. LONGITUDINAL SWAY BRACING: Longitudinal sway bracing shall be provided at 40'-0" intervals.
- D. VERTICAL RUNS: Vertical runs of conduit shall be braced at not more than 10'-0" vertical intervals.
- E. ANCHOR RODS, ANGLES, AND BARS: Anchor rods, angles, and bars shall be bolted to either conduit clamps at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified hereinafter. Anchor rods, angles, and bars shall not exceed lengths given in Table I.
- F. BOLTS: Bolts used for attachment of anchors to pipe and structure shall be not less than 1/2" diameter.

**TABLE I
MAXIMUM LENGTH FOR BRACING MEMBERS**

TYPE	SIZE	MAXIMUM LENGTH*	ALLOWABLE LOADS* (Kips)
ANGLES	1-1/2" x 1-1/2" x 1/4"	4'-10"	5.7

	2" x 2" x 1/4"	6'-6"	7.8
	2-1/2" x 1-1/2" x 1/4"	8'-0"	9.8
	3" x 2-1/2" x 1/4"	8'-10"	10.8
	3" x 3" x 1/4"	9'-10"	11.9
RODS	3-4"	3'-1"	3.7
	7-8"	3'-8"	5.0
FLAT BARS	1-1/2" x 1/4"	1'-2"	3.1
	2" x 1/4"	1'-2"	4.1
	2" x 3/8"	1'-9"	6.2
PIPES (40S)	1"	7'-0"	4.1
	1-1/4"	9'-0"	5.5
	1-1/2"	10'-4"	6.6
	2"	13'-1"	8.9

* Based on the slenderness of $1/r = 200$ and ASTM A36 steel.

3.2 SPREADERS

- A. Spreaders shall be provided between racked or adjacent conduit runs to prevent contact during seismic activity whenever surfaces are less than 4" apart or four times the maximum displacement due to seismic force. Spreaders to be applied at same interval as sway braces.

3.3 ANCHOR BOLTS

- A. All floor or pad mounted equipment will have a minimum of four anchor bolts securely fastened through base. Two nuts shall be provided on each bolt. Anchor bolts shall have an embedded straight length equal to at least 10 times the nominal diameter of the bolt and shall conform to the following Tables of sizes for various equipment weights, in accordance with ASTM A325 and A576.

MAXIMUM EQUIPMENT WEIGHT (POUNDS)	MINIMUM BOLT SIZES* (INCHES)
500	3/8
1,000	1/2
5,000	5/8
10,000	3/4
20,000	7/8
30,000	1
50,000	1-1/4
100,000	1-1/2

* Based on four bolts per item, use equivalent total cross sectional areas when more than four bolts per item are provided. Anchor bolts that exceed normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.

- B. When height-to-width ratio of the equipment exceeds 8.9, overturning must be investigated.

3.4 EQUIPMENT SWAY BRACING

- A. Equipment sway bracing shall be provided for all items supported from overhead floor or roof structures. Braces shall consist of angles, rods, bars, or pipes run at a 45° angles.

3.5 LIGHTING FIXTURES IN BUILDING

- A. In addition to the requirements of the preceding paragraphs, lighting fixtures and supports will conform to the following:

3.6 MATERIALS AND CONSTRUCTION

- A. Fixture supports shall be malleable iron.
- B. Loop and hook or swivel hanger assemblies for pendant fixtures shall be fitted with a restraining device to hold the stem in the support position during earthquake motions. Pendant supported fluorescent fixtures shall also be provided with a flexible hanger device at the attachment to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.
- C. Recessed fluorescent individual or continuous row fixtures shall be supported by a seismic resistant suspended ceiling support system and shall be bolted thereto at each corner of the fixture; or shall be provided with fixture support wires attached to the building structural members using 2 wires for individual fixtures and 1 wire per unit of continuous row fixtures.
- D. A supporting assembly that is intended to be mounted on an outlet box shall be designed to accommodate mounting features on 4" boxes, 3" plaster rings, and fixture studs.
- E. Surface mounted fluorescent individual or continuous row fixtures shall be attached to a seismic resistant ceiling support system. Fixture support devices for attaching to suspended ceilings shall be a locking-type scissor clamp or full loop band that will securely attach to the ceiling support. Fixtures attached to underside of a structural slab shall be properly anchored to the slab at each corner or the fixture.

- F. Each wall mounted emergency light unit shall be secured in a manner to hold the unit in place during a seismic disturbance.
- G. TESTS: In lieu of the requirements for equipment supports, lighting fixtures and the complete fixture supporting assembly may be tested as specified hereinafter. Such tests shall be conducted by an approved and independent testing laboratory, and the results of such tests shall specifically state whether or not the lighting fixture supports satisfy the requirements given herein.
1. TEST EQUIPMENT: To simulate earthquake motion, fixtures and supports shall be attached to a carriage suspended on rollers from an overhead track. A gear motor and crank assembly shall be used to provide oscillatory motion of approximately 1 cycle per second. The exact number of cycles per second and the actual dimension of the crank apparatus shall be adjusted to produce a minimum carriage acceleration of 0.28 g. The actual fixture mounting surface shall be on the underside of the carriage and shall provide capacity for orienting the fixture in a horizontal plane in various positions ranging from parallel to perpendicular to the line of traverse.
 2. TEST REQUIREMENTS: All tests shall be conducted with the maximum fixture weight so as to produce the most severe loading conditions. Fixtures having stems shall be tested with the actual stem lengths to be used. Tests shall be of 1 minute duration with the mounting surface in the line of traverse, at 45° to the line of traverse, and at 90° to the line of traverse. A total of 2 fixtures shall be tested in each of the above positions. After each of the 6 tests, the complete stem assemblies from fixtures having stem assemblies shall be subjected to a tensile strength test. The sample shall withstand, without failure, a force of not less than 4 times the weight it is intended to support.
 3. ACCEPTANCE: No component of a fixture nor its supports shall be accepted individually. For acceptance, the fixture and its supports shall exhibit no undue damage, and no component of the fixture shall fail or fall from the fixture during testing.

3.7 RECESSED LIGHTING FIXTURES

- A. Recessed lighting fixtures not over 56 pounds in weight and suspended and pendant hung fixtures not over 70 pounds in weight may be supported and attached directly to the ceiling system runners by a positive attachment such as screws or bolts.

END OF SECTION

SEISMIC PROTECTION

SECTION 26 24 00

PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Panelboards and switchboards.

1.2 SPARE PARTS

- A. Keys: Furnish two for each panel to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square 'D', Siemens, Eaton/Cutler Hammer. Use bolted circuit breakers .

2.2 MAIN AND DISTRIBUTION PANELBOARDS

NOTE: ALL MAIN PANELS AND SERVICE DISCONNECTS SHALL HAVE TVSS

- A. Enclosure: NEMA 1 indoors; NEMA 3R outdoors. Provide doors with cylinder locks on all panels.
- B. Panel short circuit rating (unless shown otherwise on Drawings):
 - 1. 208/240 volts: for 100 amp through 300 amp, 22,000 RMS; for 301 amp through 800 amp, 42,000 RMS.
 - 2. 277/480 volts: For 100 amp through 300 amp, 14,000 RMS; for 301 amp through 800 amp, 25,000 RMS.

- C. Molded Case Circuit Breakers: NEMA AB 1; provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits and HID/SWD for all breakers used to switch lighting circuits. Verify breakers for A/C equipment prior to rough-in. Provide G.F.I. type circuit breakers for all heating cable and immersion heaters.
- D. All main disconnect devices located inside shall have shunt trip operators.
- E. All flush mounted panelboards shall fit in 6" nominal stud wall.
- F. Where buildings are sprinklered furnish shunt trip breakers for elevator drives and control power (connected via the fire alarm to shut off power prior to sprinkler activation. Provide one auxilliary contact to shut off car emergency battery power as well. Coordinate with the fire alarm vendor and elevator supplier.
- G. ALL KITCHEN RECEPTACLES SINGLE AND THREE PHASE SHALL HAVE GFI PROTECTION AT EITHER THE RECEPTACLE IF IT REMAINS ACCESSIBLE OR AT THE BREAKER. RECEPTACLES UNDER KITCHEN HOODS WITH FIRE PROTECTION SHALL BE SHUNT TRIP AND CONNECTED TO SUPPRESSION SYSTEM. GFI PROTECTION SHALL CONFORM TO THE LATEST NEC.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards plumb and flush with wall finishes in conformance with NEMA PB 1.1 unless noted as surface-mounted. Provide filler plates for unused spaces in panelboards.
- B. Provide typed circuit directory under plastic for each branch circuit panelboard. The circuit directory shall indicate the load served. Circuits feeding lighting and receptacles shall be labled as per which room is served (use owner's room naming system).
- C. Stub four empty 3/4-inch conduits to accessible location above ceiling out of each recessed panelboard.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall switches, receptacles and plates.

1.2 SUBMITTALS

- A. Submit product data showing configurations, finishes, dimensions, and manufacturer's instructions. **Note if contractor does not request color selection from Architect he shall change all devices and plates as directed by Architect.**

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Hubbell, Leviton unless shown otherwise.

2.2 WALL SWITCHES

- A. Wall switches shall be commercial grade.
- B. Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: NEMA WD 1; AC general use snap switch with toggle handle, rated 20 amperes and 120-277 volts AC-**Color as selected by Architect.**
- C. Pilot Light Type: (light on with load on) used to indicate a load is on (e.g. remote exhaust fan).
- D. Lighted Toggle Type: (light on with load off) used to locate switch where it may be difficult to find in the dark.
- E. Manufacturer Catalog Numbers as listed in table below:

2.3 RECEPTACLES

- A. Receptacles shall be specification grade heavy duty unless otherwise shown on the drawings.
- B. Convenience and Straight-blade Receptacles: NEMA WD 1 - 20 Amp: 5-20R, one piece ground strap construction - **Color as selected by Architect.**

- C. GFI Receptacles: 20 Amp duplex convenience receptacle with integral ground fault current interrupter. Slaving of GFI's not permitted unless shown otherwise. Provide GFI protection for all receptacles in kitchens. In addition provide GFI receptacles at all locations within 6' of a water outlet.
- D. Tamper Resistant. Install commercial grade tamper resistant devices as defined and as required by code. **VERIFY LATEST CODE REQUIREMENTS.**

2.4 WALL DIMMERS

- A. Wall Dimmers: Dimmers shall be compatible with the LED (or other) fixtures specified. **Color as selected by Architect. Note; all devices on a project shall be from one vendor if possible so that color etc matches.**

2.5 WALL PLATES

- A. Cover plates – **302 Stainless Steel shall be standard.** If desired by Architect (confirm prior to submittals) a nylon plate can be used. Color as selected by Architect. Submit stainless plates unless directed otherwise in writing by the architect. If plastic plates are substituted without specific change proposal request the contactor shall replace with stainless steel.
- B. Weatherproof Cover Plate: Thomas & Betts, "In use" Red-Dot "Code Keeper". Complete unit shall be made of die cast copper-free* aluminum alloy including flip cover. Plastic units are not acceptable. (*less than .004 copper content). Flip lid types are permitted only where allowed by code.
- C. Furnish blank plates for openings without a device.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install receptacle behind E.W.C. so cord will not show. Provide GFI protection for all water cooler outlets. This can be a GFI breaker or slaved and properly labeled from a bathroom GFI receptacle.

END OF SECTION

SECTION 26 28 00
DISCONNECT SWITCHES

PART 1 - GENERAL

PART 2 - PRODUCTS

2.1 MANUFACTURERS - DISCONNECT SWITCHES

- A. Square D, Eaton, Siemens

2.2 DISCONNECT SWITCHES

- A. Fusible Switch Assemblies: NEMA KS 1; Heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Handle lockable in OFF position. Fuse Clips: FS W-F-870, designed to accommodate Class R fuses with solid neutral. General duty may be used for A/C disconnects under 100 amps.
- B. Nonfusible Switch Assemblies: NEMA KS1; Type HD; FS W-S-865; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Handle lockable in OFF position. General duty may be used for disconnects under 100 amps.
- C. Enclosures:
 - 1. NEMA 1: Indoors.
 - 2. NEMA 3R: Outdoors.
 - 3. As indicated on Drawings.

2.3 MANUFACTURERS - FUSES

- A. Bussman: Fusetrons for motors, Low Peak or Hi-Cap elsewhere and at service.

2.4 FUSES

- A. Fuses 600 Amperes and Less: ANSI/UL 198E, Class Low Peak. as indicated on Drawings; dual element, current limiting, time delay, 200 or 600 volt as required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated on Drawings and as required by code. Install a disconnecting means within sight of all motors (whether shown or not).
- B. Install heavy duty switches for service entrances and 100 amps and above.
- C. If switches are mounted on equipment, provide 12 inches of flexible conduit next to switch between switch and panel.
- D. In locating disconnects for mechanical and other equipment the electrical contractor shall coordinate carefully with the other trades and insure that disconnects do not get mounted behind mechanical or other equipment. Insure Code required clearances are maintained.

END OF SECTION

SECTION 26 32 23
AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.1 Summary

A This section includes the following items from a single supplier:

1. Automatic transfer switch

B Related Requirements

1. It is the intent of this specification to secure an automatic transfer switch that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
2. Any exceptions to the published specifications shall be subject to the approval of the engineer and submitted minimum 10 days prior to the closing of the bid with a line by line summary description of all the items of compliance, any items that have been omitted or have been taken exception to, and a complete description of all deviations.
3. It is the intent of this specification to secure an automatic transfer switch that has been tested during design verification, in production, and at the final job site. The automatic transfer switch will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
4. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

1.2 Submittals

A Action Submittals

1. Product Data
 - a The submittal shall include specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.
2. Shop Drawings

B Closeout Submittals

1. Operation And Maintenance Data
2. Warranty Documentation

1.3 Quality Assurance

A Regulatory Agency

1. The automatic transfer switch shall conform to the requirements of the following codes and standards:
 - a UL 1008 - Standard for Transfer Switch Equipment
 - b IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
 - c NFPA 70 - National Electrical Code
 - d NFPA 99 - Essential Electrical Systems for Health Care Facilities
 - e NFPA 110 - Emergency and Standby Power Systems
 - f IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
 - g NEMA Standard ICS 10-2005, Electromechanical AC Transfer Switch Equipment.
 - h EN61000-4-4 Fast Transient Immunity Severity Level 4
 - i EN61000-4-5 Surge Immunity Class 4 (voltage sensing and programmable inputs only)
 - j IEEE 472 (ANSI C37.90A) Ring Wave Test
 - k IEC Specifications for EMI/EMC Immunity (CISPR 11, IEC 1000-4-2, IEC 1000-4-3, IEC 1000-4-4, IEC 1000-4-5, IEC 1000-4-6, IEC 1000-4-8, IEC 1000-4-11)
 - l CSA C22.2 No. 178 certification

2. Qualifications
 - a The automatic transfer switch shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
 - b A manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year shall produce the automatic transfer switch.

3. Manufacturers
 - a The automatic transfer switch shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.
 - b The manufacturer shall maintain a national service organization of employing personnel located throughout the contiguous United States. The Service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
 - c The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

1.4 Field or Site Conditions

A Ambient Conditions

1. Automatic transfer switch shall operate in the following conditions without any damage to the unit or its loads.
 - a Ambient Temperature: -4 to 158 Degrees F
 - b Relative Humidity: 5% to 95% noncondensing

1.5 Warranty or Bond

A Manufacturer's Warranty

1. The ATS shall include a standard warranty covering one (1) year to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup.
2. The ATS manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

PART 2 PRODUCTS

2.1 Equipment

A Equipment

1. Furnish and install a service entrance rated automatic transfer switch with 3-Pole / 4-Wire, Solid Neutral, 400 Amps, 120/240V/60Hz. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

B Manufacturer

1. Automatic transfer switches shall be Kohler Service Entrance Rated - Programmed Transition KEP-DFTC-0400S-NK or approved equal. Any alternate shall be submitted for approval to the consulting engineer at least 10 days prior to bid date.

C Construction

1. The transfer switch shall be electrically operated and mechanically held with double throw construction, and operated by a momentarily energized solenoid-driven mechanism.
2. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
3. The switch shall be positively locked and unaffected by momentarily outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
4. All main contacts shall be silver composition. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 800 amperes and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
5. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.
6. For two and three pole switches, where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.

D Enclosure

1. The ATS shall be furnished in a NEMA 3R enclosure.
2. All standard door mounted switches and indicating LEDs shall be integrated into a flush-mounted, interface membrane or equivalent in the enclosure door for easy viewing & replacement. The panel shall be capable of having a manual locking feature to allow the user to lockout all membrane mounted control switches to prevent unauthorized tampering. This cover shall be mounted with hinges and have a latch that may be padlocked. The membrane panel shall be suitable for mounting by others when furnished on open type units.

2.2 Operation

A Controls

1. A four line, 20 character LCD display and dynamic 4 button keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and control through the communications interface port or USB. The following parameters shall only be adjustable via a password protected programming on the controller:
 - a Nominal line voltage and frequency
 - b Single or three phase sensing
 - c Operating parameter protection
 - d Transfer operating mode configuration (Standard transition, Programmed transition, or Closed transition)

B Voltage and Frequency

1. Voltage (all phases) and frequency on both the normal and emergency sources shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

a	Parameter	Dropout/Trip	Pickup/Reset
b	Under voltage	75 to 98%	85 to 100%
c	Over voltage	106 to 135%	95 to 100% of trip
d	Under frequency	95 to 99%	80 to 95%
e	Over frequency	01 to 115%	105 to 120%
f	Voltage unbalance	5 to 20%	3 to 18%
2. Repetitive accuracy of all settings shall be within $\pm 0.5\%$ over an operating temperature range of -20°C to 70°C .
3. An adjustable dropout time for transient voltage and frequency excursions shall be provided. The time delays shall be 0.1 to 9.9 seconds for voltage and .1 to 15 seconds for frequency.
4. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad, remotely via the communications interface port or USB.
5. The controller shall be capable of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or BAC). Unacceptable phase rotation shall be indicated on the LCD; the service required LED and the annunciation through the communication protocol and dry contacts. In addition, the phase rotation sensing shall be capable of being disabled, if required.
6. The controller shall be capable of detecting a single phasing condition of a source, even though a voltage may be regenerated by the load. This condition is a loss of phase and shall be considered a failed source.
7. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases (phase to phase and phase to neutral), frequency,

and phase rotation.

C Time Delays

1. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 12 or 24 VDC power supply.
2. A time delay shall be provided on transfer to the emergency source, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
3. A time delay shall be provided on re-transfer to normal. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
4. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
5. A time delay activated output signal shall also be provided to drive external relay(s) for selective load disconnect and reconnect control. The controller shall be capable of controlling a maximum of 9 individual output time delays to step loads on after a transfer occurs. Each output may be individually programmed for their own time delay of up to 60 minutes. Each sequence shall be independently programmed for transferring from normal to emergency and transferring from emergency to normal.
6. All time delays shall be adjustable in 1 second increments.
7. All time delays shall be adjustable by using the display and keypad, with a remote device connected to the communications interface port or USB.
8. Each time delay shall be identified and a dynamic countdown shall be shown on the display. Active time delays can be viewed with a remote device connected to the communications interface port or USB.

D Additional Features

1. The controller shall have 3 levels of security. Level 1 shall allow monitoring of settings and parameters only. The Level 1 shall be capable of restricted with the use of a lockable cover. Level 2 shall allow test functions to be performed and Level 3 shall allow setting of all parameters.
2. The display shall provide for the test functions, allowed through password security. The test function shall be load, no load or auto test. The auto test function shall request an elapsed time for test. At the completion of this time delay the test shall be automatically ended and a retransfer sequence shall commence. All loaded tests shall be immediately ended and retransfer shall occur if the emergency source fails and the normal source is acceptable.
3. A contact closure shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
4. Auxiliary contacts shall be provided consisting of a minimum of two contacts, closed when the ATS is connected to the normal source and two contacts closed, when the ATS is connected to the emergency source.
5. LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
6. LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal (green) and emergency sources (red), as determined by the voltage, frequency and phase rotation sensing trip and reset settings for each source.

7. A membrane switch shall be provided on the membrane panel to test all indicating lights and display when pressed.
8. Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
9. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which closes to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad, communications interface port or USB. A "not-in-auto" LED shall indicate anytime the controller is inhibiting transfer from occurring.
10. The programmed transition feature shall control the transfer so that mechanism is placed in a load disconnect position for an adjustable period of time, giving motor and transformer loads and opportunity to decay to acceptable levels. The programmed transition feature shall be specifically designed for and be the product of the ATS manufacturer. The programmed transition setting shall be capable of being enabled or disabled from the user interface, communications interface port or USB. The controller shall include a built-in time delay for programmed transition operation. This time shall be adjustable from the user interface. The default value shall be 1 second and shall be adjustable from 0 to 60 minutes.
11. A time based load control feature shall be available to allow the prioritized addition and removal of loads based during transfer. This feature may be enabled for either or both sources. The user shall be able to control up to nine loads with independent timing sequences for pre and post transfer delays in either direction of transfer.
12. The controller shall provide 2 inputs for external controls that can be programmed from the following values:
 - a Common fault, Remote test, Inhibit transfer, Low battery voltage, Peak shave, Time delay bypass, Load shed forced to OFF position (Programmed transition only)
13. The controller shall provide two form "C" contact outputs rated for up to 12A @ 240VAC or 2A @ 480VAC that can be programmed from the following values:
 - a Aux switch open, Transfer switch aux contact fault, Alarm silenced, Alarm active, I/O communication loss, Contactor position, Exercise active, Test mode active, Fail to transfer, Fail to acquire standby source, Source available, Phase rotation error, Not in automatic mode, Common alarm, In phase monitor sync, Load bank control active, Load control active, Maintenance mode active, Non-emergency transfer, Fail to open/close, Loss of phase, Over/under voltage, Over/under frequency, Voltage unbalance, Start signal, Peak shave active, Preferred source supplying load, Standby source supplying load
14. The controller shall be capable of expanding the number of inputs and outputs with additional modules.
15. Optional input/output modules shall be furnished which mount on the inside of the enclosure to facilitate ease of connections.
16. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to 21 different exercise routines based on a calendar mode. For each routine, the user shall be able to:
 - a Enable or disable the routine
 - b Enable or disable transfer of the load during routine.
 - c Set the start time, time of day, day of week, week of month (1st, 2nd, 3rd, 4th, alternate or every)
 - d Set the duration of the run.
 - e At the end of the specified loaded exercise duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. All loaded exercises shall be immediately ended and retransfer shall occur if the standby source fails. The next exercise period shall be displayed on the main screen with the type of

- exercise, time and date. The type of exercise and the time remaining shall be display when the exercise is active. It shall be possible of ending the exercise event with a single button push.
17. Date and time - The date shall automatically adjust for leap year and the time shall have the capability of automatically adjusting for daylight saving and standard times.
 18. System Status - The controller shall have a default display the following on:
 - a System status
 - b Date, time and type of the next exercise event
 - c Average voltage of the preferred and standby sources
 - d Scrolling through the displays shall indicate the following:
 - 1) Line to line and line to neutral voltages for both sources
 - 2) Frequency of each source
 - 3) Load current for each phase (include necessary CT's)
 - 4) Single or three phase operation
 - 5) Type of transition
 - 6) Preferred source
 - 7) Commit or no commit modes of operation
 - 8) Source/source mode
 - 9) In phase monitor enable/disable
 - 10) Phase rotation
 - 11) Date and time
 19. Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.
 20. Self-Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.
 21. Communications Interface - The controller shall be capable of interfacing, through a standard communication with a network of transfer switches and generators. It shall be able to be connected via an RS-485 serial communication (up to 4000 ft. direct connect or multi-drop configuration). This module shall allow for seamless integration of existing or new communication transfer devices and generators.
 22. The transfer switch shall also be able to interface to 3rd party applications using Modbus RTU open standard protocols utilizing Modbus register maps. Proprietary protocols shall not be acceptable.
 23. The controller shall contain a USB port for use with a software diagnostic application available to factory authorized personnel for downloading the controller's parameters and settings; exercise event schedules; maintenance records and event history. The application can also adjust parameters on the controller.
 24. Data Logging - The controller shall have the ability to log data and to maintain the last 2000 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory. The controller shall be able to display up to the last 99 events. The remaining events shall be accessible via the communications interface port or USB.
 - a Event Logging
 - 1) Data, date and time indication of any event
 - b Statistical Data
 - 1) Total number of transfers*
 - 2) Total number of fail to transfers*
 - 3) Total number of transfers due to preferred source failure*
 - 4) Total number of minutes of operation*
 - 5) Total number of minutes in the standby source*

- 6) Total number of minutes not in the preferred source*
 - 7) Normal to emergency transfer time
 - 8) Emergency to normal transfer time
 - 9) System start date
 - 10) Last maintenance date
 - 11) * The statistical data shall be held in two registers. One register shall contain data since start up and the second register shall contain data from the last maintenance reset.
25. External DC Power Supply - An optional provision shall be available to connect up to two external 12/24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead for extended periods of time. This module shall contain reverse battery connection indication and circuit protection.

2.3 Service Entrance Switch

- A. A two position disconnect switch shall be provided to disconnect the normal source and inhibit during maintenance or emergency.
 - i. The controller shall display SERVICE DISCONNECT
 - ii. Further transfer is inhibited after transfer to Emergency
- B. Molded case circuit breakers (MCCB) shall be 80% rated. Molded case switches (MCSW) shall be 100% rated. Insulated case circuit breakers and insulated case switches shall be 100% rated.
- C. The transfer switch mechanism shall provide a simple means of manual operation using only components, which are permanently affixed, in the operating position.
- D. The unit shall permit manual operation of the transfer switch while the system is energized and carrying rated load. Transfer switches, which require all sources of power to be de-energized prior to manual load transferring, shall not be acceptable.
- E. A control circuit isolation plug shall be provided to isolate all control circuitry inside the transfer switch to facilitate maintenance procedures. When isolated, there shall be no voltage present on the control circuitry.
- F. Cable Connections: Provision shall be made to terminate all incoming and outgoing power cables and grounding conductors. Connections shall be via screw type cable lugs.
- G. The Power Switching units shall be fix-mounted, utilize fully enclosed contacts and their withstand/closing rating shall be equal to or exceed the required withstand rating of the complete mechanism.
- H. The service entrance rated automatic transfer switch shall automatically transfer the load to the generator supply in the event of a utility supply failure and return the load to the utility supply upon restoration. The transfer switch shall incorporate an isolating mechanism and over current protection on the utility supply to allow operation of the main services disconnect in accordance with NEC requirements. The transfer switch power switching devices shall be mechanically and electrically interlocked to prevent the utility and generator supplies from being interconnected.
- I. Molded Case Circuit Breaker Service Entrance Rated Transfer Switches
 - i. The normal connection shall be provided with an electronic trip, 80% rated molded case breaker with a 400 amp current rating.

2.4 Accessories

- A. Padlockable User Interface Cover. The user interface cover shall protect the controller user interface from the environment.

- B. Controller Disconnect Switch. A Logic disconnect switch shall be mounted inside the enclosure, and shall disconnect power to controller without disconnecting the load. The logic disconnect switch shall disconnect utility power to the controller during maintenance and service without disconnecting power to the load. The switch has two positions, auto and disconnect. The disconnect position shall disconnect the voltage sensing leads for the utility source (A, B, C, N). It is assumed that the user shall disable the generator by placing the controller in the OFF position.
- C. Supervised Transfer Control Switch. The supervised transfer control switch shall provide a door mounted, three position, selector switch with Auto, Manual and Transfer positions.
 - a. With the controller set to the automatic mode and the selector switch in the Auto position, the user transfer switch shall operate normally.
 - b. With the controller set to the automatic mode and the selector switch in the Manual position, the user shall be required to toggle the selector switch to initiate a transfer from the emergency to the normal position.
 - c. With the controller set to the non-automatic mode and the selector switch in the Manual position, the user shall be required to toggle the selector switch to the transfer position to initiate a transfer in either direction. In this mode, the ATS shall not automatically transfer to an acceptable source in the case of source failure, without the user toggling the selector switch to the transfer position.
- D. Programmable Exerciser. A programmable exerciser shall be supplied to allow programming of up to 56 on/off events.

2.5 Source Quality Control

- A Test and Inspection
 - 1. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
 - 2. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

END OF SECTION

SECTION 26 50 00

LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Luminaires and accessories.

1.2 SUBMITTALS

- A. Submit product data including **color chips**, support points, weights, and accessory information for each luminaire type.

1.3 QUALITY ASSURANCE

- A. Furnish interior ceiling fixtures compatible with ceiling system. Coordinate with ceiling system installer. Verify prior to ordering.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - LUMINAIRES AND ACCESSORIES

- A. See Fixture Schedule on Drawings.
- B. All request for substitutions shall be accompanied by factory certified computer printouts of performance of substituted fixture showing foot candles on Floor Plan.
- C. All LED color temperatures shall be the same for all fixtures on the project. Verify color prior to bidding if it affects pricing. Verify prior to ordering.

2.2 LIGHTING POLES

- A. Provide fuses in pole at hand hole for each ballast.
- B. All poles shall have full base cover and galvanized anchor bolts.
- C. All poles shall be 7 gage. Minimum rating shall be for 80 MPH winds.

2.3 OCCUPANCY SENSORS

- A. Ceiling mounted occupancy sensors shall be Greengate or approved equal.
- B. Wall mounted occupancy sensors shall be Greengate series or approved equal. Adjust each sensor as recommended.
- C. Locate sensors so that there is full room coverage. Provide additional sensors if required for irregular rooms or where pendant mounted fixtures obstruct the sensor.
- D. INCLUDE 0-10V WIRING TO ALL DIMMABLE FIXTURES REGARDLESS OF INDICATION OF DIMMERS AT THIS TIME. THIS ALLOWS FOR DIMMING AS SHOWN IN ADDITION TO FUTURE CHANGES.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Connection to light fixtures shall be from j-box directly to fixture (fixture to fixture wiring not permitted except where fixtures are run in continuous runs such as lighting coves).
- B. Support surface-mounted luminaires directly from building structure. Support lay in fixtures according to Code.
- C. Layout work to ensure that ceiling outlets are located symmetrically in area.
- D. Luminaire Pole Bases: Size and constructed as indicated on Drawings. Provide galvanized anchor bolts and project anchor bolts 3 inches minimum above base. Install poles on bases plumb; lock into place as directed by manufacturer. Grout around pole base. In traffic areas base shall extend 30 inches above pavement. VERIFY HEIGHT WITH THE ARCHITECT.
- E. Arrange fixtures to miss ducts and equipment in Mechanical Room and to miss air ducts in other areas.
- F. Each pole shall be furnished with pole base cover whether indicated on the fixture schedule or not.

3.2 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Touch up luminaire and pole finish at completion of work.

END OF SECTION

SECTION 27 30 00

TELECOMMUNICATION RACEWAY SYSTEM

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Provide a complete raceway system for telecommunications. Cabling etc not in this contract. Refer to plans for additional information.

PART 2 – PRODUCTS

2.1 BOXES AND CONDUITS

- A. Unless noted otherwise on the drawings, telecommunication outlet boxes shall be 4" square by 2-1/8" deep with single gang plaster ring. Extend 1" conduit from telecommunications outlet box to above accessible ceiling area. Conduit ends shall be outfitted with a plastic bushing prior to the installation of cables.
- B. In facilities where more than one telephone closet is required provide raceways between rooms. Provide either a cable tray system or a minimum of two 4" conduits.
- C. Include in the bid provision for the boxes and conduits required for card access to the room. Verify prior to work.
- D. Conduits entering the phone room from above the rack shall penetrate a minimum of 2" into the closet. If from floor extend to 4" AFF.
- E. Provide blank filler module for any unused openings.
- F. Provide a minimum of two 4" conduits from the service point on the site to the data closet. If not shown on the plans assume the furthest point on the site for bid purposes then verify with the service company. Use long sweep bends. Include pull boxes or manholes to keep the maximum number of 90 degree bends to two. Terminate these conduits in a pull box on the site. Include pull strings and cap the conduits on both ends to be water proof.

2.2 PLYWOOD BACKBOARDS

- A. Each Telecommunications Room shall have $\frac{3}{4}$ " AC grade plywood floor to ceiling on all walls (finished side out). Paint plywood with white fire resistant paint.

2.3 GROUNDING

- A. Each telecommunication rack shall be grounded via a #4 insulated conductor to grounding plate.

2.4 POWER REQUIREMENTS

- A. Include a minimum of two 20A/120 circuits and two quad receptacles just to feed the data rack. Locate as directed by owners vendor. Include service outlets on all walls fed by an additional dedicated circuit.

2.5 Smoke detection

- A. If there is a building fire alarm system include smoke detection in the room.

2.6 RACK AND CABLING MANAGEMENT

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Installation of all equipment shall comply with EIA/TIA 568 and the latest addition of the NEC.

END OF SECTION

SECTION 28 31 00
FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. At the time of bid, all exceptions taken to these Specifications, all variances from these Specifications and all substitutions of operating capabilities or equipment called for in these Specifications shall be listed in writing and forwarded to the consulting engineer. Any such exceptions, variances, or substitutions which were not listed at the time of bid and are identified in the submittal shall be grounds for immediate disapproval without comment.

- B. Installation company shall be licensed by the State of Arkansas in accordance with ACA 17-33-101 et.seq., and shall have been in business minimum 5 years installing fire alarm systems. In addition the equipment and materials shall be provided by a franchised distributor. Technicians must be factory trained. Submit copy of training certificate with submittals.

1.2 SYSTEM DESCRIPTION

- A. Provide complete fire alarm system of the general alarm horn/strobe type. The system shall include but not be limited to the following:
 - 1. Addressable analog intelligent fire alarm control panel.
 - 2. Annunciator panel. Locate as directed by Fire Department.
 - 3. Manual fire alarm stations.
 - 4. Smoke detectors.
 - 5. Alarm horns and flasher horns.
 - 6. Visual alarm lights - ADA rated (visual devices to have mutli-candela settings within a single unit as manufactured by Wheelock or approved equal).
 - 7. Central station alarm and trouble connection. Provide cellular dialer and internet communication.

8. Standby battery backup.

1.3 APPLICABLE CODES AND STANDARDS

- A. All equipment shall be U.L. and FM listed for its intended use.
- B. IBC Section 907 Fire Alarm and Detection Systems and NFPA.
- C. All raceways and wiring shall be installed in compliance with NFPA Standard 70 (National Electrical Code - Article 760).
- D. The system equipment and its installation shall comply with all other local codes and authorities having jurisdiction.

1.4 ELEVATORS AND MACHINE ROOMS

- A. If there is an elevator and sprinkler system on the project; the fire alarm system shall activate shunt trip breakers for the elevator controls and motors and open the sprinkler pre-action valve as directed by the state elevator inspector. In addition make provisions to open the power to the emergency let down circuit if supplied in the shunt trip arrangement if emergency power is supplied.
- B. Install smoke detectors in all enclosed elevator lobbies, machine rooms and in the hoistway. Interface these with the elevator control system.
- C. Provide elevator recall for all buildings as directed by the AHJ.

1.5 ADA AUDIBLE/VISUAL SYSTEMS

- A. **Provide an area of rescue/refuge intercom system to meet code requirements.**

1.6 SUBMITTALS

- A. Provide list of all types of equipment and components provided.
- B. Provide description of operation of the system, similar to that provided in Part 2 of this section, to include any and all exceptions, variances, or substitutions listed at the time of bid.

1.7 WARRANTY

- A. The equipment manufacturer shall guarantee the system equipment to the Owner for a period of one year from the date of final acceptance of the system.
- B. The Contractor shall guarantee all wiring and raceways to be free from inherent mechanical or electrical defects for one year from the date of final acceptance of the system.

1.8 ACCESS CONTROL SYSTEMS.

- A. Where there is any sort of door access system this contractor shall provide a relay and connection to directly interrupt power to the locks (as per NFPA).

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. As shown on Drawings (all systems shall have spare capacity in the control panel).
- B. All lines exiting the building shall have surge suppression.
- C. **All cable shall be plenum rated.**

2.2 ACCEPTABLE VENDORS

- A. The acceptable vendors are:
 - 1. AlarmTec Systems
 - 2. Encore Technology Solutions
 - 3. Reliable Fire Protection

- B. Other vendors may submit for approval 10 days prior to bid. Provide a minimum of eight references and information to verify the other requirements of this specification. If accepted the Engineer will put the newly accepted vendor in an addendum approving them for this project. **Vendors not listed here or in an addendum are not permitted.**

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install entire system in accordance with approved manufacturer's wiring diagrams. Furnish all conduit, wiring, outlet boxes, junction boxes, cabinets, and similar devices necessary for the complete installation. All wiring shall be of the type and size recommended by the manufacturer and shall be approved by the local fire department. Install wiring in dedicated conduit throughout.
- B. Install outside horns flush and weatherproof.
- C. Install smoke detectors in all mechanical closets and a duct detector in the supply plenum (and a firestat in the return) **of all** HVAC units (supply and return smoke detectors if over 15000 CFM) - see Mechanical Drawings for ratings.
- D. Install pull stations at each exterior door and exits from floors and no further than 200' apart.
- E. Install horn with strobe in each corridor, stairwell and as shown on Drawings and install strobes in public toilets. Strobe location shall comply with ADA.
- F. Provide connection to elevator recall controls.
- G. Extend phone lines to the main phone board for connection to the phone system. Provide all required fire alarm components for this connection.
- H. Install smoke detector at FAP whether indicated on the plans or not.
- I. Kitchen fire suppression systems shall be connected to the fire alarm panel whether indicated on the drawings or not. In addition provide connection to building automation system.
- J. Install smoke detectors on either side of doors that are equipped with door hold open devices whether indicated on the drawings or not.
- K. Refer to mechanical drawings and provide duct mounted smoke detectors at all smoke dampers and the appropriate controls. Make all required power and control connections.

3.2 TESTS

- A. Each individual system operation, on an address by address and circuit by circuit basis, shall be tested for its complete operation. Procedure for testing the entire fire alarm system shall be set forth with the consent of the code enforcement official, the Engineer, and the manufacturer.

3.3 DOCUMENTATION AND TRAINING

- A. The Contractor shall compile and provide to the Owner four complete manuals on the finished system. Each manual shall include operating and maintenance instructions, catalog cuts of all equipment and components, all as-built wiring diagrams (both floor plan and riser types) and a manufacturer's spare parts list.
- B. In addition to the above manuals, the Contractor shall provide the service of a trained manufacturer's employee for not less than a four hour session, during normal business hours, to instruct the Owner's designated personnel on the operation and maintenance of the entire system.

END OF SECTION

**A NEW BRANCH BANK FOR
FIRST COMMUNITY BANK
LEPANTO, AR**

Civil Specifications

February 8, 2023

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The Civil Engineer of Record for
A NEW BRANCH BANK FOR
FIRST COMMUNITY BANK
In Lepanto, AR is:



Date 2/8/23

Crafton, Tull & Associates, Inc. Project
#22807000

SECTION 31 00 00

SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
- B. Section Includes
 - 1. Demolition of structures, paving, and utilities.
 - 2. Filling voids created as a result of removals or demolition.
- C. Related Sections
 - 1. Section 311000 - Site Clearing
 - 2. Section 312000 - Earthwork

1.2 REGULATORY REQUIREMENTS

- A. Conform to applicable State and local codes for demolition of structures, safety of adjacent structures, dust control, and runoff control.
- B. Obtain required permits and licenses from appropriate authorities. Pay associated fees including disposal charges.
- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Do not close or obstruct public or private roadways, sidewalks, or fire hydrants without appropriate permits or written authorization.
- E. Conform to applicable regulatory procedures when hazardous or contaminated materials are discovered.
- F. Test soils around buried tanks for contamination.

1.3 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of capped utilities and subsurface obstructions that will remain after demolition. Submit record as part of closeout submittals.

1.4 PROJECT CONDITIONS

- A. Structures to be demolished will be discontinued in use and vacated prior to start of work.
- B. Owner assumes no responsibility for condition of structures to be demolished.
- C. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as reasonably practical. Variations within structures may occur by Owner's removal and salvage operations prior to start of demolition work.

- D. Unless otherwise indicated in Contract Documents or specified by the Owner, items of salvageable value to Contractor shall be removed from site and structures. Storage or sale of removed items on site will not be permitted without consent of the Owner and shall not interfere with other work specified.
- E. Explosives shall not be brought to site or used without written consent of authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility for injury to persons or for damage to property due to blasting operations. Performance of required blasting shall comply with governing regulations.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Fill material shall be aggregate fill materials as specified in Section 312000.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide, erect, and maintain erosion control devices, temporary barriers, and security devices at locations indicated on Construction Drawings.
- B. Protect existing landscaping materials, appurtenances, and structures, which are not to be demolished. Repair damage to existing items to remain caused by demolition operations.
- C. Prevent movement or settlement of adjacent structures. Provide bracing and shoring as necessary.
- D. Mark location of utilities. Protect and maintain in safe and operable condition utilities that are to remain. Prevent interruption of existing utility service to occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities as acceptable to governing authorities and Owner.
- E. Notify adjacent property owners of work that may affect their property, potential noise, utility outages, or other disruptions. Obtain written permission from adjacent property owners when demolition equipment will traverse, in

3.2 GENERAL DEMOLITION REQUIREMENTS

- A. Conduct demolition to minimize interference with adjacent structures or pavements to remain.
- B. Cease operations immediately if adjacent structures appear to be in danger. Notify authority having jurisdiction. Do not resume operations until directed by authority.
- C. Conduct operations with minimum of interference to public or private access. Maintain ingress and egress at all times.
- D. Sprinkle work with water to minimize dust. Provide hoses and water connections for this purpose.
- E. Comply with governing regulations pertaining to environmental protection.
- F. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of work.

3.3 DEMOLITION

- A. Demolish site improvements designated to be removed as shown on the drawings. Site improvements shall include but not be limited to structures, retaining walls, foundations, pavements, curbs and gutters, drainage structures, utilities, signage or landscaping.
- B. Disconnect and cap or remove utilities to be abandoned as shown on the drawings.
- C. Fill or remove underground tanks, piping, and appurtenances as shown.
- D. Demolish buildings completely and remove from site using methods as required to complete work within limitations of governing regulations. Small structures may be removed intact when acceptable to Owner and authorities having jurisdiction.
- E. Locate demolition equipment and remove materials to prevent excessive loading to supporting walls, floors, or framing.
- F. Demolish concrete and masonry in small sections. Break up concrete slabs-on-grade that are 2-feet or more below proposed subgrade to permit moisture drainage. Remove slabs-on-grade and below grade construction within 2-feet of proposed subgrade.

3.4 FILLING BASEMENTS AND VOIDS

- A. Completely fill below grade areas and voids resulting from demolition or removal of structures, underground fuel storage tanks, wells, cisterns, etc., using aggregate fill materials consisting of stone, gravel, or sand free from debris, trash, frozen materials, roots, and other organic matter.
- B. Areas to be filled shall be free of standing water, frost, frozen or unsuitable material, trash, and debris prior to fill placement.
- C. Place fill materials in accordance with Section 02300 unless subsequent excavation for new work is required.
- D. Grade surface to match adjacent grades and to provide flow of surface drainage after fill placement and compaction.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove from site debris, rubbish, and other materials resulting from demolition operations. Leave areas of work in clean condition.
- B. No burning of any material, debris, or trash on-site or off-site will be allowed except when allowed by appropriate governing authority and Owner. If allowed as stated above, burning shall be performed in manner prescribed by governing authority. Attend burning materials until fires have burned out and have been completely extinguished.
- C. Transport materials removed from demolished structures with appropriate vehicles and dispose off-site to areas that are approved for disposal by governing authorities and appropriate property owners.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Cleaning site of debris, grass, trees, and other plant life in preparation for site or building earthwork.
2. Protection of existing structures, trees, or vegetation indicated on the Construction Drawings to remain.

B. Related Sections

1. Section 310000 - Site Demolition
2. Section 312000 - Earthwork

1.2 ENVIRONMENTAL REQUIREMENTS

A. Construct temporary erosion control systems as shown on Construction Drawings or as directed by the "Storm Water Pollution Prevention Plan" (SWPPP) to protect adjacent properties and water resources from erosion and sedimentation.

B. In event that sitework on this project will disturb 1 or more acres; Contractor shall not begin construction without "National Pollution Discharge Elimination System" (NPDES) permit governing discharge of storm water from site for entire construction period. NPDES permit requires SWPPP to be in place during construction.

C. Contractor shall conduct storm water management practices in accordance with NPDES permit and shall enforce action taken or imposed by Federal or State agencies, including cost of fines, construction delays, and remedial actions resulting from Contractor's failure to comply with provisions of NPDES permit.

1.3 PROJECT CONDITIONS

A. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as reasonably practical.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify existing plant life that is to remain and verify clearing limits are clearly tagged, identified, and marked in such manner as to ensure their protection throughout construction operations.

3.2 PROTECTION

- A. Locate, identify, and protect existing utilities that are to remain.
- B. Protect trees, plant growth, and features designated to remain as part of final landscaping.
- C. Conduct operations with minimum interference to public or private accesses and facilities. Maintain ingress and egress at all times and clean or sweep roadways daily as required by SWPPP or governing authority. Dust control shall be provided with sprinkling systems or equipment provided by Contractor.
- D. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by a licensed land surveyor and replaced, as necessary, in kind.
- E. Provide traffic control as required, in accordance with the US Department of Transportation's "Manual on Uniform Traffic Control Devices" and applicable state highway department requirements.

3.3 EQUIPMENT

- A. Material shall be transported to and from the project site using well-maintained and operating vehicles. Transporting vehicles operating on site shall stay on designated haul roads and shall not endanger improvements by rutting, overloading, or pumping.

3.4 CLEARING

- A. Clear areas required for access to site and execution of work.
- B. Unless otherwise indicated on Construction Drawings, remove trees, shrubs, grass, other vegetation, improvements, or obstructions interfering with installation of new construction. Removal includes digging out stumps and roots. Depressions caused by clearing and grubbing operations shall be filled to subgrade elevation to avoid ponding of water. Satisfactory fill material shall be placed in accordance with Section 312000.
- C. Remove grass, trees, plant life, stumps, and other construction debris from site to dump site that is suitable for handling such material according to state laws and regulations.
- D. Cut heavy growths of grass from areas before stripping and topsoil removal and remove cuttings with remainder of cleared vegetative material.

END OF SECTION

SECTION 31 20 00

EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation, filling, and backfilling for structures and pavement.
2. Trenching and backfilling for utilities.
3. Dewatering.
4. Boring under crossings.

B. Related Sections

1. Section 312800 - Erosion Control and Sedimentation

- C. Order of Precedence: Geotechnical Engineering Report specifies requirements for earthwork preparation and placement of fill. The foundation design and site grading recommendations shall take precedence over the provisions of this section whenever duplication or conflict occurs.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)

5. ASTM D 422 - Standard Test Method For Particle Size Analysis of Soil
6. ASTM D 698 - Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN.m/m³))
7. ASTM D 1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 Kn.m/m³))
8. ASTM D 2922 - Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
9. ASTM D 4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils

B. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO T 88 - Particle Size Analysis of Soils

C. State Department of Transportation (DOT):

1. Standard Specifications for Construction and Materials

D. National Fire Protection Association (NFPA)

- 1.NFPA 70 - National Electrical Code

E. American Water Works Association (AWWA)

1. AWWA C200 - Standard For Steel Water Pipe - 6 In. (150 Mm) And Larger
2. AWWA C206 - Field Welding Of Steel Water Pipe

1.3 QUALITY ASSURANCE

- A. An independent testing laboratory, selected and paid for by the Contractor, will be retained to perform construction testing on site.

1. The independent testing laboratory shall prepare test reports that indicate test location, elevation data, and test results. Owner, Civil Engineering Consultant, and Owner shall be provided with copies of reports within 96 hours of time that test was performed. In event that test performed fails to meet Specifications, the independent testing laboratory shall notify Owner and Contractor immediately.
2. Costs related to retesting due to failures shall be paid for by the Contractor at no additional expense to Owner. Contractor shall provide free access to site for testing activities.
3. Quality assurance testing will be conducted in accordance with Paragraph "Field Testing" in Part 3 hereinafter.

1.4 DEFINITIONS

- A. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than allowed for fill or backfill material as specified hereinafter or as shown on the drawings. Satisfactory soil shall contain no debris, waste, frozen materials, vegetation, and other deleterious matter.
- B. Unsatisfactory Materials: Materials which do not comply with the requirements for satisfactory materials are unsatisfactory including materials classified in ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.
 1. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. The Contracting Officer shall be notified of any contaminated materials.
 2. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

1.5 SUBMITTALS

- A. Submit 30-pound sample of each type of off-site fill material that is to be used at the site in airtight containers to the independent testing laboratory or submit gradation and certification of aggregate material that is to be used at the site to the independent testing laboratory for review.
- B. Submit certification that all material obtained from off-site sources complies with specification requirements.
- C. Submit name of each material supplier and specific type and source of each material. Change in source throughout project requires approval of Owner.
- D. If fabrics or geogrids are to be used, design shall be submitted for approval to Owner.
- E. Submit Dewatering Plans upon request by Owner.
- F. Shop drawings or details pertaining to excavating and filling are not required unless otherwise shown on the Drawings or if contrary procedures to Construction Documents are proposed.
- G. Shop drawings or details pertaining to site utilities are not required unless required by regulatory authorities or unless uses of materials, methods, equipment, or procedures that are contrary to The Drawings or Specifications are proposed. Do not perform work until Owner has accepted required shop drawings.

H. Contact utility companies and determine if additional easements will be required to complete project. Provide written confirmation of the status of all easements to Owner at time of Preconstruction Conference or no later than 90 days prior to project possession date.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fill and Backfill. Satisfactory soil materials excavated from the site.

B. Imported Fill Material: Satisfactory borrow material provided from offsite borrow areas when sufficient satisfactory soil materials are not available from required excavations.

C. Trench Backfill: ASTM D 2321 unless otherwise specified or shown on the drawings.

D. Building Subbase Material: Subbase for building and appurtenances slabs on ground is specified in Section 03300 or 03312 as applicable.

E. Bedding: Aggregate Type as indicated on the plans or naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

G. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

H. Topsoil: Topsoil shall consist of stripping material excavated from the site. Topsoil shall consist of organic surficial soil found in depth of not more than 12-inches. Topsoil shall be further defined in Section 329300 – Planting.

I. Filter and drainage fabrics: As specified in Section 312800.

J. Steel Casing Pipe: Comply with AWWA C200 minimum grade B, size, and wall thickness as indicated on The Drawings.

K. Trench Utility Locator Tape: Heavy duty 6" wide underground warning tape. Tape shall be made from polyethylene material, 3.5 mils thick, with a minimum tensile strength of 1,750 psi. Place the tape at one-half the minimum depth of cover for the utility line or a maximum of 3 feet, which ever is the less, but never above the top of subgrade. Color of tape shall be determined by as follows:

3. Natural Gas or Propane - Yellow
4. Electric - Red
5. Telephone – Orange
6. Water – Blue
7. Sanitary Sewer – Green

2.3 EQUIPMENT

A. Transport off-site materials to project using well-maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

2.4 SOURCE QUALITY CONTROL

A. Laboratory testing of materials proposed for use in the project shall be by the Independent Testing Laboratory at no cost to Owner. The Contractor shall provide samples of material obtained off-site.

B. In areas to receive pavement, California Bearing Ratio (CBR) or Limerock Bearing Ratio (LBR) tests shall be performed for each type of material that is imported from off-site. CBR or LBR value shall be equal to or above pavement design subgrade CBR or LBR value indicated on Construction Drawings

C. Following tests shall be performed on each type of on-site or imported soil material used as compacted fill:

1. Moisture and Density Relationship: ASTM D 698 or ASTM D 1557.
2. Mechanical Analysis: AASHTO T 88 or ASTM D422.
3. Plasticity Index: ASTM D 4318

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, datum, elevations, and grades necessary for construction as shown on the drawings.

B. Notify utility companies to remove or relocate public utilities that are in conflict with proposed improvements.

C. Protect plant life, lawns, fences, existing structures, sidewalks, paving, and curbs, unless otherwise noted on the drawings from excavating equipment and vehicular traffic.

D. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

E. Remove from site, material encountered in grading operations that, in opinion of Owner or the Contractor's Independent Testing Laboratory (ITL) is unsuitable or undesirable for backfilling, subgrade, or foundation purposes. Dispose of in manner satisfactory to Owner. Backfill areas with layers of suitable material and compact as specified herein.

F. Prior to placing fill in low areas, such as previously existing creeks, ponds, or lakes, perform following procedures:

1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain the same results.
2. After drainage of low area is complete, remove muck, mud, debris, and other unsuitable material by using acceptable equipment and methods that will keep natural soils underlying low area dry and undisturbed.
3. All muck, mud, and other materials removed from low areas shall be dried on-site by spreading in thin layers for observation by the ITL. Material shall be inspected and, if found to be suitable for use as fill material, shall be incorporated into lowest elevation of

site filling operation, but not under building subgrade or within 8'-0" of perimeter of building subgrade or paving subgrade. If, after observation by the ITL, material is found to be unsuitable, unsuitable material shall be removed from site.

- G. Locate and identify utilities that have previously been installed and protect from damage.
- H. Locate and identify existing utilities that are to remain and protect from damage.
- I. Maintain in operating condition existing utilities, previously installed utilities, and drainage systems encountered in utility installation. Repair surface or subsurface improvements shown on The Drawings.
- J. Verify location, size, elevation, and other pertinent data required making connections to existing utilities and drainage systems as indicated on The Drawings.
- K. Over excavate and properly prepare areas of subgrade that are not capable of supporting proposed systems. Stabilize these areas by using acceptable geotextile fabrics or aggregate material placed and compacted.

3.2 DEWATERING

A. General:

1. Provide dewatering systems as required for excavations.
2. Design and provide dewatering system using accepted and professional methods consistent with current industry practice to eliminate water entering the excavation under hydrostatic head from the bottom or sides. Design system to prevent differential hydrostatic head, which would result in floating out soil particles in a manner, termed as a "quick" or "boiling" condition. System shall not be dependent solely upon sumps or pumping water from within the excavation where differential head would result in a quick condition, which would continue to worsen the integrity of the excavation's stability.
3. Provide dewatering system of sufficient size and capacity to prevent ground and surface water flow into the excavation and to allow Work to be installed in a dry condition.
4. Control, by acceptable means, all water regardless of source. Contractor shall be responsible for disposal of the water.
5. Confine discharge piping or ditches to available easement or to additional easement obtained by Contractor. Provide necessary permits or easement.
6. Control groundwater in a manner that preserves strength of foundation soils, does not cause instability or raveling of excavation slopes, and does not result in damage to existing structures. Where necessary, lower water level in advance of excavation utilizing wells, wellpoints, jet educators, or similar positive methods. The water level as measured by piezometers shall be maintained a minimum of 3 feet below prevailing excavation level.
7. Commence dewatering prior to any appearance of water in excavation and continue until Work is complete to the extent that no damage results from hydrostatic pressure, flotation, or other causes.
8. Open pumping with sumps and ditches will be allowed provided it does not result in boils, loss of fines, softening of the ground, or instability of slopes.
9. Install wells or wellpoints, if required, with suitable screens and filters so that continuous pumping of fines does not occur. Arrange discharge to facilitate collection of samples by the Owner. During normal pumping and upon development of wells, levels of fine sand or silt in the discharge water shall not exceed 5 ppm. Install sand tester on discharge of each pump during testing to verify that levels are not exceeded.

10. Control grading around excavations to prevent surface water from flowing into excavation areas.

11. No additional payment will be made for any supplemental measures to control seepage, groundwater, or artesian head.

B. Design:

1. Designate and obtain the services of a qualified dewatering specialist to provide dewatering plan as may be necessary to complete the Work.
2. Contractor shall be responsible for the accuracy of the drawings, design data, and operational records required.
3. Contractor shall be responsible for the design, installation, operation, maintenance, and any failure of any component of the system.

C. Damages:

1. Contractor shall be responsible for and shall repair any damage to work in place, other contractor's equipment, utilities, residences, highways, roads, railroads, private and municipal well systems, adjacent structures, natural resources, habitat, existing wells, and the excavation. Contractor responsibility shall also include, damage to the bottom due to heave and including but not limited to, removal and pumping out of the excavated area that may result from Contractor's negligence, inadequate or improper design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system.
2. Remove subgrade materials rendered unsuitable by excessive wetting and replace with approved backfill material at no additional cost to the Owner.

D. Maintaining Excavation in Dewatering Condition:

1. Dewatering shall be a continuous operation. Interruptions due to power outages, or any other reason will not be permitted.
2. Continuously maintain excavation in a dry condition with positive dewatering methods during preparation of subgrade, installation of pipe, and construction of structures until the critical period of construction or backfill is completed to prevent damage of subgrade support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance.
3. Provide standby equipment on site, installed, wired, and available for immediate operation if required to maintain dewatering on a continuous basis in the event any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to Owner.
4. System maintenance shall include but not be limited to 24-hour supervision by personnel skilled in the operation, maintenance, and replacement of system components, and any other work required to maintain excavation in dewatered condition.

E. System Removal: Upon completion of the work, remove dewatering equipment from the site, including related temporary electrical service.

F. Wells shall be removed or cut off a minimum of 3 feet below final ground surface, capped, and abandoned in accordance with regulations by agencies having jurisdiction.

3.3 TOPSOIL EXCAVATION

A. Cut heavy growths of grass from areas before stripping and remove cuttings with remainder of cleared vegetative material.

- B. Strip topsoil to a depth of not less than 6 inches from areas that are to be filled, excavated, landscaped, or re-graded to such depth that it prevents intermingling with underlying subsoil or questionable material.
- C. Stockpile topsoil in storage piles in areas shown on The Drawings or where directed by Owner. Construct storage piles to freely drain surface water. Cover storage piles as required to prevent windblown dust. Dispose of unsuitable topsoil as specified for waste material, unless otherwise specified by Owner. Remove excess topsoil from site unless specifically noted otherwise on The Drawings.

3.4 GENERAL EXCAVATION

- A. Classification of Excavation: The Contractor shall assure himself by site investigation or other necessary means that he is familiar with the type, quantity, quality, and character of excavation work to be performed. Excavation shall be considered unclassified excavation, except as indicated in the Contract Documents.
- B. When performing grading operations during periods of wet weather, provide adequate dewatering, drainage and ground water management to control moisture of soils.
- C. Shore, brace, and drain excavations as necessary to maintain excavation as safe, secure, and free of water at all times.
- D. Excavate building areas to line and grade as shown on the Drawings being careful not to over excavate beyond elevations needed for building subgrades.
- E. Place suitable excavated material into project fill areas.
- F. Include an Undercut Allowance in the project. Stipulated cubic yards (CY) quantity to be provided by the Geotechnical Engineer. The Undercut Allowance is to include provisions for the removal, replacement and compaction of unsuitable soil. Provide unit pricing for actual quantity adjustment. Refer to Bid Form Supplements, Appendix A – Unit Prices, for schedule.
- G. Unsuitable excavated material shall be disposed of in manner and location that is acceptable to Owner and local governing agencies.
- H. Perform excavation using capable, well-maintained equipment and methods acceptable to Owner and local governing agencies.

3.5 TRENCHING EXCAVATION FOR UTILITIES

- A. Contact local utility companies before excavation begins. Dig trench at proper width and depth for laying pipe, conduit, or cable. Cut trench banks vertical, if possible, and remove stones from bottom of trench as necessary to avoid point-bearing. Over excavate wet or unstable soil, if encountered, from trench bottom as necessary to provide suitable base for continuous and uniform bedding. Replace overexcavation with suitable and dispose of unsuitable material.
- B. Trench excavation sidewalls shall be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Lateral travel distance to exit ladder or steps shall not be greater than 25 feet in trenches 4 feet or deeper.

- C. Perform trench excavation as indicated on the Drawings for specified depths. During excavation, stockpile materials suitable for backfilling in orderly manner far enough from bank of trench to avoid overloading, slides, or cave-ins.
- D. Remove excavated materials not required or not suitable for backfill or embankments and waste off-site or at on-site locations approved by the Owner and in accordance with governing regulations. Dispose of structures discovered during excavation as specified in Section 02220.
- E. Prevent surface water from flowing into trenches or other excavations by temporary grading or other methods, as required. Remove accumulated water in trenches and other excavations as specified.
- F. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel-type trenching machines are used, do not use clods for backfill.
- G. Accurately grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material at every point along entire length except where necessary to excavate for bell holes, proper sealing of pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make joint connection properly.
- H. Trench width below top of pipe shall not be less than 12 inches nor more than 18 inches wider than outside surface of pipe or conduit that is to be installed to designated elevations and grades. Other trench width for pipe, conduit, or cable shall be least practical width that will allow for proper compaction of trench backfill.
- I. Trench depth requirements measured from finished grade or paved surface shall meet the following requirements or applicable codes and ordinances, whichever is more stringent:
 1. Water Mains: 30 inches to top of pipe barrel or 6 inches below frost line, established by local building official, whichever is deeper.
 2. Sanitary Sewer: Elevations and grades as indicated on the drawings and as specified in Section 02535.
 3. Storm Sewer: Elevations and grades as indicated on the Drawings.
 4. Electrical Conduits: 24 inches minimum to top of conduit or as required by NEC 300-5, NEC 710-36 codes, or local utility company requirements, whichever is deeper.
 5. TV Conduits: 18 inches minimum to top of conduit or as required by local utility company, whichever is deeper.
 6. Telephone Conduits: 18 inches minimum to top of conduit, or as required by local utility company, whichever is deeper.
 7. Gas Mains and Service: 30 inches minimum to top of pipe, or as required by local utility company, whichever is deeper.

3.6 SUBGRADE PREPARATION

- A. Scarification and Compaction: Areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified to minimum depth of 8 inches and compacted as specified hereinafter.
- B. Proofrolling: Subgrades shall be proofrolled to detect areas of insufficient compaction. Proofrolling shall be accomplished by making minimum of 2 complete passes with fully-loaded tandem-axle dump truck with a maximum weight of 20 tons, or approved equal, in each of 2 perpendicular directions while

under the supervision and direction of the independent testing laboratory. Document and explain proofrolling inspection procedures and results in the laboratory inspection report. Areas of failure shall be excavated and recompacted as specified herein. Continual failure areas shall be stabilized in accordance with Section 02340 at no additional cost to Owner. Subgrade exposed longer than 48 hours or on which precipitation has occurred shall be re-proofrolled.

3.7 FILLING

- A. Fill areas to contours and elevations shown on the Drawings with unfrozen materials.
- B. Place fills in continuous lifts specified herein.
- C. Fill within proposed building subgrade and paving subgrade shall not contain rock or stone greater than 6 inches in any dimension.
- D. Unless otherwise specified for rock fill, rock or stone less than 6-inches in largest dimension may be used in fill below structures, paving, and graded areas, up to 24 inches below surface of proposed subgrade or finish grade of graded areas when mixed with suitable material. Rock or stone less than 2 inches in largest dimension may be used in fill within the upper 24 inches of proposed subgrade or finish grade of graded areas when mixed with suitable material.
- E. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8 inches loose measure and compacted as specified hereinafter.
- F. Material imported from off-site shall have CBR or LBR value equal to or above pavement design subgrade CBR or LBR value indicated on The Drawings.
- G. Building area subgrade pad shall be that portion of site directly beneath and 10 feet beyond building and appurtenances, including limits of future building expansion areas as shown on the Drawings.
- H. Prepare building area subgrade pad in strict accordance with the Geotechnical Engineering Report.
- I. Unless specifically stated otherwise in foundation design and site grading recommendations, the following table stipulates maximum allowable values for plasticity index (PI) and liquid limit (LL) of suitable materials to be used as fill in specified areas:

<u>Location</u>	<u>PI</u>	<u>LL</u>
Building area	20	45
Paving area	45	20

3.8 TRENCH BACKFILLING

- A. Materials used for trench backfill shall comply with requirements as specified herein.
- B. Backfill and compact in accordance with fill and compaction requirements in accordance with ASTM D 2321 unless otherwise shown on the drawings.
- C. Do not backfill trenches until required tests are performed and utility systems comply with and are accepted by applicable governing authorities.

- D. Backfill trenches to contours and elevations shown on the Drawings.
- E. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

3.9 BORINGS AND CASINGS UNDER ROADS, HIGHWAYS, AND RAILROAD CROSSINGS

- A. When indicated by the Drawings, street, road, highway, or railroad crossings for utility mains installed by jacking and boring method shall be in accordance with area specifications and governing authorities.
- B. Excavation of approach pits and trenches within right-of-way of street, road, highway, or railroad shall be of sufficient distance from paving or railroad tracks to permit traffic to pass without interference. Tamp backfill for approach pits and trenches within right-of-way in layers not greater than 6-inches thick for entire length and depth of trench or pit. Compact backfill to 98 percent of maximum density in accordance with ASTM D698, (or 95 percent of maximum density, in accordance with ASTM D1557) obtained at optimum moisture as determined by AASHTO T 180. Mechanical tampers may be used after cover of 6 inches has been obtained over top of barrel of pipe.
- C. Accomplish boring operation using commercial type boring rig. Bore hole to proper alignment and grade. Bore hole shall be within 2 inches of same diameter as largest outside joint diameter of pipe installed. Install pipe in hole immediately after bore has been made and in no instance shall hole be left unattended while open.
- D. In event subsurface operations result in failure or damage to pavement or railroad tracks within 1 year of construction, make necessary repairs to pavement or railroad tracks. If paving cracks on either side of pipe line or is otherwise disturbed or broken due to construction operations, repair or replace disturbed or broken area.
- E. Clean, prime, and line interior and exterior of casing pipe with two coats of asphalt coating in accordance with and governing authorities.
- F. Butt weld steel casing. Welds shall be full penetration single butt-welds in accordance with AWWA C206.
- G. Install casing and utility pipe with end seals, vent pipe, and other special equipment in accordance with area specifications and governing authorities.

3.10 COMPACTION

- A. Compact as follows:

Location	Percent of Maximum Laboratory Density	
	ASTM D698	ASTM D1557
Subgrade & Fill Below Structures	95	95
Subgrade & Fill Below Pavement	95	92

- B. Maintain moisture content of not less than 1 percent below and not more than 3 percent above optimum moisture content of fill materials to attain required compaction density.
- C. Exercise proper caution when compacting immediately over top of pipes or conduits. Water jetting or flooding is not permitted as method of compaction.

D. Corrective Measures for Non-Complying Compaction: Remove and recompact deficient areas until proper compaction is obtained. Continual failure areas shall be stabilized in accordance with Section 02340 at no additional cost to Owner.

3.11 MAINTENANCE OF SUBGRADE

- A. Verify finished subgrades to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction, including concrete trucks, dump trucks, and other construction equipment.
- C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in manner that will comply with compaction requirements by use of material with CBR or LBR equal to or better than that specified on the drawings. Surface of subgrade after compaction shall be firm, uniform, smooth, stable, and true to grade and cross-section.
- D. Construct temporary ditches and perform such grading as necessary to maintain positive drainage away from subgrade at all times.

3.12 BORROW AND SPOIL SITES

- A. Comply with NPDES and local erosion control permitting requirements for any and all on-site and off-site, disturbed spoil and borrow areas. Upon completion of spoil or borrow operations, clean up spoil or borrow areas in a neat and reasonable manner to the satisfaction of Owner or off-site property owner, if applicable.

3.13 FINISH GRADING

- A. Check grading of building subgrades by string line from grade stakes (blue tops) set at not more than 50-foot centers. Allowable tolerance shall be plus or minus 0.10 feet from plan grade. Provide engineering and field staking as necessary for verification of lines, grades, and elevations.
- B. Grade areas where finish grade elevations or contours are indicated on the Drawings, other than paved areas and buildings, including excavated areas, filled and transition areas, and landscaped areas. Graded areas shall be uniform and smooth, free from rock, debris, or irregular surface changes. Ground surfaces shall vary uniformly between indicated elevations. Grade finished ditches to allow for proper drainage without ponding and in manner that will minimize erosion potential. For topsoil, sodding, and seeding requirements refer to Section 329300.
- C. Correct settled and eroded areas within 1 year after date of completion at no additional expense to Owner. Bring grades to proper elevation.

3.14 FIELD TESTING

- A. Field density tests for in-place materials will be performed by the Contractor's Independent Testing Laboratory (ITL) as follows:
 - 1. Building Subgrade Areas, Including 8'-0" Outside of Exterior Building Lines: In cut areas, not less than 1 compaction test for every 2,500 sq. ft. In fill areas, same rate of testing for each 8-inch lift, measured loose.

2. Areas of Construction Exclusive of Building Subgrade Areas: In cut areas, not less than 1 compaction test for every 10,000 sq. ft. In fill areas, same rate of testing for each 8-inch lift, measured loose.
 3. Utility Trench Backfill: Intervals not exceeding 200-feet of trench for first and every other 8-inch lift of compacted trench backfill.
 4. Test Method: In-place nuclear density, ASTM D 2922 (Method B-Direct Transmission).
- B. Corrective Measures For Non-Complying Compaction: Remove and recompact deficient areas until proper compaction is obtained at no additional expense to Owner. Adjust moisture content as necessary to conform to the requirements of this section.
- C. Field testing, frequency, and methods may vary as determined by and between the Contractor and the ITL.

END OF SECTION

SECTION 31 22 00

EXCAVATION, BACKFILL, AND COMPACTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Excavation to line, grade, and configuration as shown on Construction Drawings for proposed structures and future expansion areas.
- B. Fill to line, grade, and configuration as shown on Construction Drawings for proposed structures and future expansion areas.
- C. Compacting for materials in acceptable manner as specified herein.

1.2 RELATED SECTIONS

- A. Section 312000 - Earthwork
- B. Section 312600 - Aggregate Material
- C. Construction drawings

1.3 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM) latest edition
 - 1. D422 Standard Test Method For Particle – Size Analysis of Soil
 - 2. D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN.m/m³))
 - 3. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 Kn.m/m³))
 - 4. D 2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
 - 5. D 2487 Classification of Soils for Engineering Purposes
 - 6. D 2922 Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
 - 7. D 3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
 - 8. D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
 - 1. T 88 Particle Size Analysis of Soils
 - 2. State Department of Transportation (DOT): Standard Specifications for Construction and Materials, Latest Edition

1.4 QUALITY ASSURANCE

- A. An independent testing laboratory, selected and paid by Contractor, will be retained to perform construction testing on filling operations and subgrade analysis as specified in Section 312000 and as specified herein.
- B. Testing shall be in accordance with Part 3, "Field Quality Control".

1.5 SUBMITTALS

- A. Shop drawings or details pertaining to excavating and filling for structures are not required unless otherwise shown on Construction Drawings or if contrary procedures to Contract Documents are proposed.
- B. Submit 30-pound sample of each type of material from off-site borrow sources that is to be used in backfilling in air-tight container(s) to the independent testing laboratory or submit gradation and certification of aggregate material that is to be used at the site to the independent testing laboratory for review.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fill material from on-site as specified in Section 312000 and approved by Owner.
- B. Fill material from off-site as specified in Section 312000 and approved by Owner.
- C. Aggregate material as specified in Section 312600.

2.2 EQUIPMENT

- A. Transport off-site materials to the project using well-maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify lines, elevations, and grades necessary to construct building subgrades as shown on Construction Drawings.
- B. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.
- C. Locate and identify utilities that have previously been installed and protect from damage.
- D. Locate and identify existing utilities that are to remain and protect from damage.
- E. Over excavate and properly prepare areas of subgrade that are not capable of supporting proposed structures. Stabilize these areas by using acceptable geotextile fabrics or aggregate materials placed and compacted as specified.

3.2 EXCAVATION

- A. Excavate building areas to line and grade as shown on Construction Drawings being careful not to over excavate beyond elevations needed for building subgrades unless otherwise required by the Contract Documents.
- B. Place suitable excavated material into project fill areas as specified in Section 312000.
- C. Unsuitable excavated material is to be disposed of in manner and location that is acceptable to Owner and local governing agencies.
- D. Perform excavation using capable, well-maintained equipment and methods acceptable to Owner and local governing agencies.

3.3 FILLING AND SUBGRADE PREPARATION

- A. Building area subgrade pad shall be that portion of site directly beneath and 8-feet beyond building and appurtenances, including limits of future building expansion areas as shown on Construction Drawings.
- B. Prepare building area subgrade pad in strict accordance with the Geotechnical Engineering Report. Rocks larger than 6-in. shall not be part of building subgrade fill.
- C. Areas exposed by excavation or stripping and on which building subgrade preparations are to be performed shall be scarified to a minimum depth of 8-inches and compacted to minimum of 98 percent of maximum density, in accordance with ASTM D 698, (or 95 percent of maximum density, in accordance with ASTM D 1557) at moisture content of not less than 2 percent below and not more than 3 percent above optimum moisture content. Proofroll these areas to detect areas of insufficient compaction. Accomplish proofrolling by making a minimum of 2 complete passes with a fully-loaded tandem-axle dump truck with a maximum weight of 20 tons, or approved equal, in each of 2 perpendicular directions while under supervision and direction of the independent testing laboratory. Excavate and recompact areas of failure as specified herein. Continual failure areas shall be stabilized at no additional cost to Owner.
- D. Place fill materials used in preparation of subgrade in lifts or layers not to exceed 8-inches loose measure and compacted to at least 95 percent Standard Proctor in accordance with ASTM D 698 at moisture content of not less than 2 percent below and not more than 3 percent above optimum moisture content. Unless specifically stated otherwise in The Geotechnical Engineering Report or Construction Drawings, following table stipulates maximum allowable values for plasticity index (PI) and liquid limit (LL) of suitable materials to be used as fill in specified areas:

<u>Location</u>	<u>PI</u>	<u>LL</u>
Building area	20	45

3.4 COMPACTION

- A. Maintain optimum moisture content of fill materials as specified above to attain required compaction density.
- B. Test materials in accordance with Section 312000.

- C. Corrective measures for non-complying compaction: Remove and recompact deficient areas until proper compaction is obtained at no additional expense to Owner.

3.5 MAINTENANCE OF SUBGRADE

- A. Verify finished subgrades to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction, including concrete trucks, dump trucks, and other construction equipment.
- C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in manner that will comply with compaction requirements by use of material equal to or better than that specified for fill herein. Surface of subgrade after compaction shall be firm, uniform, smooth, stable, and true to grade and cross-section.
- D. Construct temporary ditches and/or perform such grading as necessary to maintain positive drainage away from subgrade at all times.

3.6 FINISH GRADING

- A. Finish grading shall be in accordance with Section 312000 and as specified herein.
- B. Check grading of building subgrades by string line from grade stakes (blue tops) set at not more than 50-foot centers. Tolerance of 0.10-foot will be permitted. Contractor to provide engineering and field staking necessary for verification of lines, grades, and elevations.

3.7 FIELD QUALITY CONTROL

- A. See Section 312000, "Field Testing".

END OF SECTION

SECTION 31 23 00

EXCAVATION, BACKFILL, AND COMPACTION FOR UTILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Excavation of trenches for installation of utilities.
- B. Backfilling trenches with bedding material as specified and filling trenches with suitable material to proposed subgrade.
- C. Compacting backfill materials in acceptable manner.
- D. Borings and casings under roads.

1.2 RELATED SECTIONS

- A. Section 310000 - Site Demolition
- B. Section 312000 - Earthwork
- C. Section 334100 - Storm Drainage
- D. Section 312600 - Aggregate Materials
- E. Construction Drawings

1.3 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM) latest edition
 - 1. D422 Standard Test Method For Particle – Size Analysis of Soil
 - 2. D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN.m/m³))
 - 3. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 Kn.m/m³))
 - 4. D 2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
 - 5. D 2487 Classification of Soils for Engineering Purposes
 - 6. D 2922 Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
 - 7. D 3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
 - 8. D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
 - 1. T 88 Particle Size Analysis of Soils
 - 2. State Department of Transportation (DOT): Standard Specifications for Construction and Materials, Latest Edition

1.4 QUALITY ASSURANCE

- A. An independent testing laboratory will perform testing at intervals not exceeding 200-feet of trench for first and every other 8-inch lift of compacted trench backfill and furnish copies of results as specified herein.
- B. Testing shall be in accordance with Part 3, "Field Quality Control".

1.5 SUBMITTALS

- A. Shop drawings or details pertaining to site utilities are not required unless required by regulatory authorities or unless uses of materials, methods, equipment, or procedures that are contrary to Construction Drawings or Specifications are proposed. Do not perform work until Owner has accepted required shop drawings.
- B. Contact utility companies and determine if additional easements will be required to complete project. Provide written confirmation of the status of all easements to Owner at time of Preconstruction Conference or no later than 90 days prior to project possession date.
- C. Submit 30-pound sample of each type of fill material from off-site borrow sources that is to be used in backfilling, in air-tight container(s), to the independent testing laboratory or submit gradation and certification of aggregate material that is to be used at the site to the independent testing laboratory for review.

1.6 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of subsurface utilities, structures, and obstructions installed or encountered.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Bedding Material: Aggregate Type as indicated on the plans and as specified in Section 312600.
- B. Haunching Material: As specified in Section 312600. Aggregate Type as indicated on the plans and as specified in Section 312600.
- C. Backfill material from the site as specified in Section 312000 and approved by Owner.
- D. Backfill material from off-site as specified in Section 312000 and approved by Owner.
- E. Steel Casing Pipe: Comply with AWWA C200 minimum grade B, size, and wall thickness as indicated on Construction Drawings.
- F. Backfill material shall not contain rock or stone with a maximum size greater than 2 inches.

2.2 LOCATOR TAPE

- A. Locator tape shall be heavy duty 6" wide underground warning tape. Tape shall be made from polyethylene material, 3.5 mils thick, with a minimum tensile strength of 1,750 psi. Place the

tape at one-half the minimum depth of cover for the utility line or a maximum of 3', whichever is the lesser, but never above the top of subgrade. Color of tape shall be determined by APWA Color Standards: Natural Gas- Yellow, Electric - Red, Telephone – Orange, Water – Blue, Sanitary Sewer – Green.

2.3 EQUIPMENT

- A. Transport off-site materials to project using well-maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Set lines, elevations, and grades for proposed systems.
- B. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.
- C. Maintain in operating condition existing utilities, previously installed utilities, and drainage systems encountered in utility installation. Repair surface or subsurface improvements shown on Construction Drawings.
- D. Verify location, size, elevation, and other pertinent data required making connections to existing utilities and drainage systems as indicated on Construction Drawings.
- E. Over excavate and properly prepare areas of subgrade that are not capable of supporting proposed systems. Stabilize these areas by using acceptable geotextile fabrics or additional bedding material placed and compacted.
- F. Provide dewatering systems as required for utility excavations. Dewatering systems shall comply with requirements of Section 312000.

3.2 EXCAVATION

- A. Contact local utility companies before excavation begins. Dig trench at proper width and depth for laying pipe, conduit, or cable. Cut trench banks vertical, if possible, and remove stones from bottom of trench as necessary to avoid point-bearing. Over excavate wet or unstable soil, if encountered, from trench bottom as necessary to provide suitable base for continuous and uniform bedding.
- B. Trench excavation sidewalls shall be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Lateral travel distance to exit ladder or steps shall not be greater than 25-feet in trenches 4-feet or deeper.

- C. Perform excavation as indicated on Construction Drawings for specified depths. During excavation, stockpile materials suitable for backfilling in orderly manner far enough from bank of trench to avoid overloading, slides, or cave-ins.
- D. Remove excavated materials not required or not suitable for backfill or embankments and waste off site or at on-site locations approved by the Owner and in accordance with governing regulations. Dispose of structures discovered during excavation as specified in Section 310000.
- E. Prevent surface water from flowing into trenches or other excavations by temporary grading or other methods, as required. Remove accumulated water in trenches and other excavations as specified in Section 312000.
- F. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel-type trenching machines are used, do not use clods for backfill. Dispose of unsuitable material and provide other suitable material at no additional cost to Owner.
- G. Accurately grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material at every point along entire length, except where necessary to excavate for bell holes, proper sealing of pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make joint connection properly.
- H. For pipes 12 inches in diameter or smaller, total trench width below top of pipe shall be the outside diameter plus not less than 12 inches nor more than 18 inches with the pipe or conduit that is to be installed to designated elevations and grades centered in the trench. For pipe diameters greater than 12 inches, trench width below the top of pipe shall be wide enough to accommodate workmen and equipment but not less than 18 inches. Other trench width for pipe, conduit, or cable shall be least practical width that will allow for proper compaction of trench backfill.
- I. Trench depth requirements measured from finished grade or paved surface shall meet the following requirements or applicable codes and ordinances, whichever is more stringent:
 - 1. Water Mains: 30-inches to top of pipe barrel or 6-inches below frost line, established by local building official, whichever is deeper.
 - 2. Sanitary Sewer: Elevations and grades as indicated on Construction Drawings.
 - 3. Storm Sewer: Elevations and grades as indicated on Construction Drawings.
 - 4. Electrical Conduits: 24-inches minimum to top of conduit or as required by NEC 300-5, NEC 710-36 codes, or local utility company requirements, whichever is deeper.
 - 5. TV Conduits: 18-inches minimum to top of conduit or as required by local utility company, whichever is deeper.
 - 6. Telephone Conduits: 18-inches minimum to top of conduit, or as required by local utility company, whichever is deeper.
 - 7. Gas Mains and Service: 30-inches minimum to top of pipe, or as required by local utility company, whichever is deeper.

3.3 PIPE BEDDING

- A. Accurately cut trenches for pipe or conduit that is to be installed to designated elevations, 4 inches below bottom of pipe and to the width as specified herein. Place 4 inches of bedding material, compact in bottom of trench, and accurately shape to conform to lower portion of pipe barrel.

3.4 BACKFILLING

- A. Criteria: Do not backfill trenches until required tests are performed and utility systems comply with and are accepted by applicable governing authorities. Backfill trenches as specified in Sections 312000 and one or more of the following sections, as applicable: 312200 for trenches below structures or 312400 for trenches below pavements. If improperly backfilled, reopen to depth required to obtain proper compaction. Backfill and compact, as specified herein, to properly correct the condition in an acceptable manner.
- B. Backfilling: After pipe or conduit has been installed, bedded, and tested as required, backfill trench or structure excavation with specified material placed as given in the Construction Documents.
- C. Backfill trenches to contours and elevations shown on Construction Drawings with unfrozen materials.
- D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

3.5 COMPACTION

- A. Exercise proper caution when compacting immediately over top of pipes or conduits. Water jetting or flooding is not permitted as method of compaction.
- B. Maintain optimum moisture content of fill materials as specified in Section 312000 to attain required compaction density.
- C. Materials used for backfill shall comply with requirements of Section 312600 and as specified herein.

3.6 BORINGS AND CASINGS UNDER ROADS, HIGHWAYS, AND RAILROAD CROSSINGS

- A. When indicated by Construction Drawings, street, road, highway, or railroad crossings for utility mains installed by jacking and boring method shall be in accordance with area specifications and governing authorities.
- B. Excavation of approach pits and trenches within right-of-way of street, road, highway, or railroad shall be of sufficient distance from paving or railroad tracks to permit traffic to pass without interference. Tamp backfill for approach pits and trenches within right-of-way in layers not greater than 6-inches thick for entire length and depth of trench or pit. Compact backfill to 95 percent of maximum density in accordance with ASTM D698, (or 95 percent of maximum density, in accordance with ASTM D1557) obtained at optimum moisture as determined by AASHTO T 180. Mechanical tampers may be used after cover of 6 inches has been obtained over top of barrel of pipe.
- C. Accomplish boring operation using commercial type boring rig. Bore hole to proper alignment and grade. Bore hole shall be within 2 inches of same diameter as largest outside joint diameter of pipe installed. Install pipe in hole immediately after bore has been made and in no instance shall hole be left unattended while open.
- D. In event subsurface operations result in failure or damage to pavement or railroad tracks within 1 year of construction, make necessary repairs to pavement or railroad tracks at no additional

cost to Owner. If paving cracks on either side of pipe line or is otherwise disturbed or broken due to construction operations, repair or replace disturbed or broken area at no additional cost to Owner.

- E. Clean, prime, and line interior and exterior of casing pipe with two coats of asphalt in accordance with area specifications and governing authorities.
- F. Butt weld steel casing. Welds shall be full penetration single butt-welds in accordance with AWWA C206 and AWS D7-0-62.
- G. Install casing and utility pipe with end seals, vent pipe, and other special equipment in accordance with area specifications and governing authorities.

3.7 FIELD QUALITY CONTROL

See Section 312000, "Field Quality Control".

END OF SECTION

SECTION 31 24 00

EXCAVATION, BACKFILL, AND COMPACTION FOR PAVEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Excavation to line, grade, and configuration as shown on Construction Drawings for proposed and future pavement areas.
- B. Fill to line, grade, and configuration as shown on Construction Drawings for proposed and future pavement areas.
- C. Compacting fill materials in acceptable manner as specified herein.

1.2 RELATED SECTIONS

- A. Section 312000 - Earthwork
- B. Section 321206 - Base Course
- C. Section 312600 - Aggregate Materials
- D. Section 321216 - Asphaltic Concrete Paving
- E. Section 321333 - Curbs and Sidewalks
- F. Construction Drawings

1.3 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM) latest edition
 - 1. D422 Standard Test Method For Particle – Size Analysis of Soil
 - 2. D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN.m/m³))
 - 3. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 Kn.m/m³))
 - 4. D 2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
 - 5. D 2487 Classification of Soils for Engineering Purposes
 - 6. D 2922 Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
 - 7. D 3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
 - 8. D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
 - 1. T 88 Particle Size Analysis of Soils
 - 2. State Department of Transportation (DOT): Standard Specifications for Construction and Materials, Latest Edition

1.4 QUALITY ASSURANCE

- A. Independent Testing Laboratory, selected and paid by Contractor, will be retained to perform construction testing on filling operations and subgrade analysis as specified in Section 02300 and as specified herein.
- B. Testing shall be in accordance with Part 3, Section 3.07, "Field Quality Control".

1.5 SUBMITTALS

- A. Shop drawings or details pertaining to excavating and filling for pavement are not required unless otherwise required by the Construction Documents or if contrary procedures to Construction Documents are proposed.
- B. Submit 30-pound sample of each type of off-site fill material that is to be used in backfilling in air-tight container to independent testing laboratory or submit gradation and certification of aggregate material that is to be used to independent testing laboratory for review.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fill material from on-site as specified in Section 312000 and approved by Owner.
- B. Fill material from off-site as specified in Section 312000 and approved by Owner.
- C. Aggregate material as indicated on the plans and as specified in Section 312600.

2.2 EQUIPMENT

- A. Transport off-site materials to project using well-maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify lines, elevations, and grades necessary to construct pavements, curb, curb and gutter, bases, sidewalk, and roadways as shown on Construction Drawings.
- B. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.
- C. Locate and identify site utilities that have previously been installed and protect from damage.
- D. Locate and identify existing utilities that are to remain and protect from damage.

- E. Over-excavate and properly prepare areas of subgrade that are not capable of supporting proposed systems. Stabilize these areas by using acceptable geotextile fabrics or aggregate material placed and compacted.

3.2 EXCAVATION

- A. Excavate roadway and pavement areas to line and grade as shown on Construction Drawings.
- B. Place suitable material into project fill areas as specified in Section 02300.
- C. Unsuitable excavated material is to be disposed of in manner and location that is acceptable to Owner and local governing agencies.
- D. Perform excavation using capable, well-maintained equipment and methods acceptable to Owner and local governing agencies.

3.3 FILLING AND SUBGRADE PREPARATION

- A. Areas exposed by excavation or stripping and on which subgrade preparations for paving are to be performed, including future pavement areas, shall be scarified to minimum depth of 8-inches and compacted to not less than 95 percent of maximum density, in accordance with ASTM D 698 (or 95 percent of maximum density, in accordance with ASTM D 1557) at moisture content of not less than 2 percent below and not more than 3 percent above optimum moisture content. Proofroll these areas to detect areas of insufficient compaction. Accomplish proofrolling by making minimum of 2 complete passes with fully-loaded tandem-axle dump truck with a maximum loaded weight of 20 tons, or approved equal, in each of 2 perpendicular directions until acceptable. Excavate and recompact areas of failure as specified herein. Continual failure areas shall be stabilized at no additional cost to Owner.
- B. Place fill materials used in preparation of the subgrade in lifts or layers not to exceed 8-inches loose measure and compacted to minimum density of not less than 95 percent of maximum density, in accordance with ASTM D 698, (or 95 percent of maximum density, in accordance with ASTM D 1557) at moisture content of not less than 2 percent below and not more than 3 percent above optimum moisture content.
- C. Following table stipulates maximum allowable values for plasticity index (PI) and liquid limit (LL) of suitable fill materials to be used in specified areas, unless specifically stated otherwise on Construction Drawings:

	<u>PI</u>	<u>LL</u>
Paving Area	20	45

- D. Fill material imported from off-site or fill material removed from onsite cut areas shall have CBR or LBR value equal to or greater than pavement design subgrade CBR or LBR value indicated on Construction Drawings.

3.4 COMPACTION

- A. Maintain optimum moisture content of fill materials as specified herein to attain required compaction density.

- B. Test materials in accordance with Section 312000.
- C. Corrective measures for non-complying compaction: Remove and recompact deficient areas until proper compaction is obtained at no additional expense to Owner.
- D. Construct temporary ditches and/or perform such grading as necessary to maintain positive drainage away from subgrade at all times.

3.5 MAINTENANCE OF SUBGRADE

- A. Verify finished subgrades to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction including concrete trucks, dump trucks, and other construction equipment.
- C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

3.6 FINISH GRADING

- A. Finish grading shall be in accordance with Section 312000 and as specified herein.
- B. Check grading of paving areas by string line from grade stakes (blue tops) set at not more than 50-foot centers. Tolerances of 0.10-foot, more or less, will be permitted. Contractor is to provide engineering and field staking necessary for verification of lines, grades, and elevations.

3.7 FIELD QUALITY CONTROL

- A. See Section 312000, "Field Quality Control".

END OF SECTION

SECTION 31 26 00

AGGREGATE MATERIALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Aggregate materials for use as specified in other Sections.

1.2 RELATED SECTIONS

- A. Section 310000 – Site Demolition
- B. Section 311000 – Site Clearing
- C. Section 312000 – Earthwork
- D. Section 312200 – Excavation, Backfill, and Compaction for Structures
- E. Section 312300 – Excavation, Backfill, and Compaction for Utilities
- F. Section 312400 – Excavation, Backfill, and Compaction for Pavement
- G. Section 312800 – Erosion Control and Sedimentation
- H. Construction Drawings

1.3 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM) latest edition
 - 1. C136 Method for Sieve Analysis of Fine and Coarse Aggregates
 - 2. D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN.m/m³))
 - 3. D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 Kn.m/m³))
 - 4. D2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
 - 5. D2487 Classification of Soils for Engineering Purposes
 - 6. D2922 Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
 - 7. D3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
 - 8. D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
 - 1. T 88 Particle Size Analysis of Soils
- C. State Department of Transportation (DOT): Standard Specifications for Construction and Materials, Latest Edition.

1.4 QUALITY ASSURANCE

- A. Tests and analysis of aggregate materials will be performed in accordance with ASTM and AASHTO procedures specified herein.

1.5 SUBMITTALS

- A. Submit 30-pound sample of each aggregate or mixture that is to be incorporated into project in air-tight containers to the independent testing laboratory or submit gradation and certification of aggregate material that is to be incorporated into project to the independent testing laboratory for review.
- B. Submit name of each material supplier and specific type and source of each material. Any change in source requires approval of Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Construction and materials shall meet or exceed requirements of this Section and applicable state highway department specifications section(s) referred to or noted on the Construction Drawings which pertain to paving base course design, materials, preparation, and execution. Materials shall be as indicated in the Construction Documents and shall comply with state highway department specifications regarding source, quality, gradation, soundness, absorption, liquid limit, plasticity index, and mix proportioning.
- B. Soil Materials
 - 1. Class II: Coarse-Grained Soils; conforming to ASTM D2487 Group Symbol, GW, GP, SW and SP.
 - 2. Class III: Coarse-Grained Soils with Fines; conforming to ASTM D2487 Symbol GM, GC, SM and SC.
 - 3. Class IV-A: Fine-Grained Soils (inorganic); conforming to ASTM D2487 Group Symbol ML and CL.
 - 4. Class IV-B: Fine Grained Soils (inorganic); conforming to ASTM D2487 Group Symbol MH and CH.
 - 5. Class V: Organic Soils; conforming to ASTM D2487 Group Symbol OL, OH, and PT.
- C. Aggregate Material
 - 1. Coarse Aggregate Type A1: Material shall be sound crushed limestone, crushed slag, granulated slag, crushed gravel, or other types of suitable material meeting the requirements of this section. Crushed limestone, crushed slag and crushed gravel shall meet the following grading requirements:

Sieve Size	Percent Passing
1 1/2 inches	100
1 inch	75-100
3/4 inch	60-100
3/8 inch	35-75
No. 4	30-60
No. 30	7-30
No. 200	0-5

2. Coarse Aggregate Type A2: Material shall be crushed carbonate, crushed gravel, crushed air-cooled slag, granulated slag, a mixture of crushed and granulated slag, or other types of suitable material meeting the requirements of this item. Crushed carbonate stone or mixtures of crushed and granulated slags shall meet the following gradation requirements:

Sieve Size	Percent Passing
2 inches	100
1 inch	70-100
3/4 inch	50-90
No. 4	30-60
No. 30	7-30
No. 200	0-5

3. Aggregate Type A3: Pea Gravel – Natural stone; washed, free of clay, shale, organic matter; graded in accordance with ASTM C136 and D2487; to the following limits:

- a. Minimum size: 1/4 inch
- b. Maximum Size: 5/8 inch

4. Fine Aggregate Type A4: Sand – Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter; graded in accordance with ASTM C136 and D2487; within the following limits:

Sieve Size	Percent Passing
No. 4	90-100
No. 50	7-40
No. 200	0-5

5. Class I-A: Material shall be sound crushed limestone, crushed slag, granulated slag, crushed gravel, or other types of suitable material meeting the requirements of this item. Crushed limestone, crushed slag and crushed gravel shall meet the following grading requirements:

Sieve Size	Percent Passing
1-1/2 inches	100
No. 4	≤ 10
No. 200	< 5

6. Class I-B: Material shall be crushed carbonate, crushed gravel, crushed air-cooled slag, granulated slag, a mixture of crushed and granulated slag, or other types of suitable material meeting the requirements of this item. Crushed carbonate stone or mixtures of crushed and granulated slags shall meet the following gradation requirements:

Sieve Size	Percent Passing
1-1/2 inches	100
No. 4	≤ 50
No. 200	< 5

2.2 EQUIPMENT

- A. Transport off-site materials to project using well-maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger any improvements by rutting, overloading, or pumping.

PART 3 - EXECUTION

3.1 STOCKPILING

- A. Stockpile on-site at locations indicated by Owner in such manner that there will be no standing water or mixing with other materials.

3.2 BORROW AND SPOIL SITES

- A. Upon completion of borrow and/or spoil operations, clean up borrow and/or spoil areas as indicated on Construction Drawings in neat and reasonable manner to satisfaction of property owner and Owner.

END OF SECTION

SECTION 31 28 00

EROSION AND SEDIMENTATION CONTROL

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Installation of temporary and permanent erosion and sedimentation control systems.
 - 2. Installation of temporary and permanent slope protection systems.
- B. Related Sections
 - 1. Section 311000 - Site Clearing
 - 2. Section 312000 - Earthwork
 - 3. Storm Water Pollution Prevention Plan
 - 4. Construction Drawings (“Site Maps”)

1.2 ENVIRONMENTAL REQUIREMENTS

- A. Protect adjacent properties, any identified endangered or threatened species or critical habitat, any identified cultural or historic resources, and receiving water resources from erosion and sediment damage until final stabilization.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Seed, sod, and ground covers for the establishment of vegetation.
- B. Sediment control devices as specified on the Construction Drawings.
- C. Rolled erosion control products according to Erosion Control Technology Council (ECTC) standard specifications.
- D. Temporary mulches such as loose, straw, wood cellulose, or agricultural silage.
- E. Temporary and permanent outfall structures as specified on the drawings.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Review the drawings and Storm Water Pollution Prevention Plan.
- B. Revise SWPPP as necessary to address potential pollution from site identified after issuance of the SWPPP at no additional cost to owner.
- C. Conduct storm water pre-construction meeting with Site Contractor, all ground-disturbing Sub-contractors, site engineer of record or someone from their office familiar with the site and SWPPP, and state or local agency personnel in accordance with requirements of the special conditions.

3.2 EROSION AND SEDIMENTATION CONTROL AND SLOPE PROTECTION
IMPLEMENTATION

- A. Place erosion and sediment control systems in accordance with the drawings and Storm Water pollution Prevention Plan or as may be dictated by site conditions in order to maintain the intent of the specifications and permits.
- B. Deficiencies or changes on the drawings or Storm Water Pollution Prevention Plan shall be corrected or implemented as site conditions change. Changes during construction shall be noted in the Storm Water Pollution Prevention Plan and posted on the drawings (Site Maps).
- C. Owner has authority to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations and to direct Contractor to provide immediate permanent or temporary pollution control measures.
- D. Maintain temporary erosion and sedimentation control systems as dictated by site conditions, indicated in the construction documents, or as directed by governing authorities or Owner to control sediment until final stabilization. Contractor shall respond to maintenance or additional work ordered by Owner or governing authorities immediately, but in no case, within not more than 48 hours if required at no additional cost to the Owner.
- E. Contractor shall incorporate permanent erosion control features, paving, permanent slope stabilization, and vegetation into project at earliest practical time to minimize need for temporary controls.
- F. Permanently seed and mulch cut slopes as excavation proceeds to extent considered desirable and practical.
- G. Unless required within a shorter timeframe by the applicable General Permit for Storm Water Discharges Associated with Construction Activity, slopes that erode easily or that will not be graded for a period of 14 days or more, shall be temporarily stabilized as work progresses with vegetation or other acceptable means unless otherwise specified in the Contract Documents. In the event it is not practical to seed areas, slopes must be stabilized with mulch and tackifier, bonded fiber matrix, netting, blankets or other means to reduce the erosive potential of the area.

END OF SECTION

SECTION 31 31 16

TERMITE CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Soil treatment for termite control at new building. Includes applying toxicant to designated soil, re-treating during warranty period when subsequent active termite infestation is detected.

1.2 REFERENCES

- A. Environmental Protection Agency:
 - 1. EPA FIFRA - Federal Insecticide, Fungicide and Rodenticide Act.
- B. National Pest Management Association:
 - 1. NPMA WDO - Wood Destroying Organism Library.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal procedures.
- B. Product Data: Submit toxicants to be used, composition by percentage, dilution schedule, intended application rate. Include product label information.
- C. Test Reports: Indicate regulatory agency approval reports.
- D. Manufacturer's Application Instructions: Indicate caution requirements and in accordance with current product label of chosen pesticide.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements.
- B. Project Record Documents: Record moisture content of soil before application, date and rate of application, areas of application, and diary of toxicity meter readings and corresponding soil coverage.
- C. Operation and Maintenance Data: Indicate re-treatment schedule.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum 5 years documented experience.
- B. Applicator: Company specializing in performing the Work of this section with minimum 10 years documented experience, approved by manufacturer and licensed at Project location.

1.6 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five year warranty.
- C. Warranty: Include coverage for damage and repairs to building and building contents caused by termites. Repair damage. Re-treat where required.
- D. Inspect and report annually to Owner in writing.
- E. Owner has option of extending damage guarantee contract at an annual fee mutually agreed upon by the Owner and the applicator. Owner reserves the right to cancel as of any anniversary date.
- F. The contract is non-cancellable by the applicator.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Toxicant Chemical: Local authority approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.

2.2 MIXES

- A. Mix toxicant to manufacturer's instructions, to a uniform consistency.
- B. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- C. Verify final grading and excavation are complete.
- D. Apply toxicant just prior to installation of vapor barrier under slabs-on-grade in accordance with product label supplemented by the NPCA's ARP for termiticiding or local requirements.

3.2 APPLICATION

- A. Apply toxicant at Project building site, before footings and slabs are placed.
- B. Apply extra treatment to structure penetration surfaces including pipe or ducts, and soil penetrations including grounding rods or posts.
- C. Re-treat disturbed treated soil with same toxicant as original treatment.
- D. When inspection or testing identifies presence of termites, re-treat soil and re-test.

3.3 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished Work.
- B. Do not permit soil grading over treated work.
- C. Re-treat disturbed treated soil with same toxicant as original treatment.

END OF SECTION

SECTION 32 12 06

BASE COURSE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Aggregate base for asphaltic concrete and Portland cement concrete paving including sand/shell base and hot-mix sand asphalt base.
- B. Related Sections
 - 1. Section 312000 – Earthwork

1.2 REFERENCES

- A. Asphalt Institute
- B. State Highway Department Standard Specifications

1.3 QUALITY ASSURANCE

- A. An independent testing laboratory, selected and paid by Contractor, will be retained to perform construction testing of in-place base course for compliance with requirements for thickness, compaction, density, and tolerances. Paving base course tolerances shall be verified by rod and level readings on not more than 50-foot centers to be not more than 0.05-feet above design elevation which will allow for paving thickness as shown on Construction Drawings. Contractor shall provide instruments and suitable benchmark.

1.4 SUBMITTALS

- A. Submit materials certificate to the independent testing laboratory that is signed by materials producer and Contractor, certifying that materials comply with, or exceed, requirements specified herein or on the Construction Drawings.
- B. Submit certification of base course materials and placement as specified in Parts 2 and 3 hereinafter.

1.5 WEATHER LIMITATIONS

- A. Do not place aggregate when base surface temperature is less than 40 degrees F, nor when air temperature is below 45 degrees F. Do not place aggregate when surface is wet or frozen. Do not place aggregate when weather conditions are unfavorable otherwise.

PART 2 - PRODUCTS

2.1 BASE COURSE MATERIAL

- A. Aggregate Base Course: Aggregate base course shall consist of a well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction. Base course may consist of a granular base (crushed slag, stone, or gravel, etc), sand/shell base material, or a hot-mix sand asphalt base.

- B. Base course shall be as shown on the drawings, or when not shown, shall be as specified herein.
- C. Aggregate base material requirements from State or other local highway agency specifications may be use for aggregate base course for roads, streets, or similar use pavements if the following conditions are met:
 - 1. Percentage of material by weight passing the No. 200 sieve will not exceed 10.
 - 2. Portion of the material passing the No. 40 sieve must have a liquid limit not greater than 25 and a plasticity index not greater than 5.
- D. Aggregate shall consist of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, angular sand, or other approved material. Aggregate shall be free of lumps of clay, organic matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.
 - 1. Coarse aggregates shall be angular particles of uniform density.
 - 2. Fine aggregates shall be angular particles of uniform density. Fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.
- E. Gradation: The specified gradation requirements shall apply to the completed base course. The aggregates shall have a maximum size of 2 inches and shall be continuously well graded within the following limits:

GRADATION OF AGGREGATES
Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
2 inch	100	----	----
1-1/2 inch	70-100	100	----
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-10	0-10	0-10

NOTE: Particles having diameters less than 0.0008 inch shall not be in excess of 3 percent by weight of the total sample tested.

- F. Hot-mix Sand Asphalt Bases: Asphalt Institute Type VI, VII, or VIII Mixes for Hot-mix Sand Asphalt Bases. Hot-Mix base shall be used only under asphaltic concrete surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Contractor shall verify to the Owner in writing that the subgrade has been inspected, tested, and gradients and elevations are correct, dry, and properly prepared in accordance with Section 02300.

3.2 CONSTRUCTION

- A. Perform base course construction in accordance with the applicable State standard specifications or as shown or specified.
- B. Perform base course construction in a manner that will drain the surface properly and prevent runoff from adjacent areas from draining onto base course construction.
- C. Compact base material to not less than 95 percent of optimum density, as determined by ASTM D 698 unless otherwise indicated on the Drawings.
- D. Construct to thickness indicated on Construction Drawings.
 - 1. Granular Base: Apply in lifts or layers not exceeding 8-inches, measured loose.
 - 2. Sand/Shell Base: Apply in lifts or layers not exceeding 4-inches, measured loose.
 - 3. Hot-mix Sand Asphalt Bases: Apply in lifts or layers not exceeding 3-inches, measured loose.

3.3 FIELD QUALITY CONTROL

- A. Field testing specified below will be performed by the Contractor's Independent Testing Laboratory at no cost to the Owner.
- B. Field testing, frequency, and methods may vary as determined by and between the Contractor and the Contractor's Testing Laboratory.
- C. Field density tests for in-place materials will be performed in accordance with the following:
 - 1. Nuclear Method: ASTM D 2922 (Method B-Direct Transmission)
 - 2. Base material thickness: One test for each 20,000 sq. ft. of in-place base material area.
 - 3. Base material compaction: One test in each lift for each 20,000 sq. ft. of in-place base material area.
- D. The independent testing laboratory will prepare reports that indicate test location, elevation data, and test results. Owner and Contractor shall be provided with copies of the reports within 96 hours of the time the test was performed. In the event that the test results show failure to meet any of the Specifications; Owner and Contractor will be notified immediately by the independent testing laboratory.
- E. The Contractor shall certify in writing to the Owner that base course placement is in accordance with specification requirements prior to subsequent work thereon.
- F. The Contractor shall pay for retesting due to failures at no additional expense to Owner. Contractor shall provide free access to the site for testing activities.

END OF SECTION

SECTION 32 12 16

ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDED

- A. Prepare subgrade to receive base course.
- B. Provide compacted base course.
- C. Place base course and place asphaltic concrete hot mix (ACHM) binder course.
- D. Tack base course and place ACHM surface course.

1.3 RELATED WORK

- A. Section 312000 - Earthwork
- B. Section 334100 - Storm Drainage
- C. Section 321333 - Concrete Curb and Gutters
- D. Section 033000 - Cast in Place Concrete

1.4 REFERENCES

- A. Arkansas State Highway and Transportation Dept. (AHTD):
 - 1. Standard Specifications for Highway Construction, Edition of 2003, hereafter referred to as "AHTD Standard Specifications".

PART 2 - PRODUCTS

2.1 BASE COURSE MATERIALS

- A. Crushed Stone: Class 7, meeting the requirements of section 303 of the AHTD Standard Specifications, or approved equal.
- B. Tack Coat: Shall be applied as specified and meeting the requirements of section 401 of the AHTD Standard Specifications.

2.2 ASPHALT PAVEMENT MATERIALS

A. ACHM Surface Course:

1. Type 2 mix as described in Sections 407 and 409 of the AHTD Standard Specifications.
2. The surface course shall be composed of a mixture of mineral aggregate and asphalt cement in the proportions by weight for the type mixture designated.

B. ACHM Binder Course:

1. Type 2 mix as described in Sections 405 and 409 of the AHTD Standard Specifications.
2. The base course shall be composed of a mixture of mineral aggregate and asphalt cement in the proportions by weight for the type mixture designated.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. Ensure grading of the subgrade to the required elevation.
- B. Scarify to a depth of six inches the subgrade where the base course is to be placed.
- C. Water and thoroughly mix subgrade until optimum moisture content is obtained when deficiency of moisture content exists. When excess of moisture exists, rework and aerate subgrade until optimum moisture content is obtained.
- D. Re-compact the subgrade to not less than 98 percent of optimum density as determined by ASTM D 698 or 95 percent of optimum density, as determined by ASTM D 1557 unless otherwise indicated on the Drawings.
- E. Before final rolling, shape the entire area to the required cross section, adding additional subsoil as required and compact the subgrade surface to the required density.

3.2 PLACEMENT OF BASE COURSE

- A. Place the crushed stone base material over the prepared subgrade in accordance with the construction methods described in section 303 of the AHTD Standard Specifications.
- B. Place the crushed stone base material over the prepared building pad at 4 inches in depth. The building slab will be placed over the compacted base material.
- C. Add water during compaction to bring the base course materials to optimum moisture content. When an excess moisture exists, rework the base course materials until optimum moisture content is obtained.
- D. Compact the base course to not less than 95 percent of optimum density, as determined by ASTM D 1557 unless otherwise indicated on the Drawings.

3.3 PLACING TACK COATS

- A. Apply the bituminous tack coat to the prepared base at the rate of 0.03 gallon to 0.10 gallon per square yard as designated by the Architect/ Engineer.
- B. Clean the base course surface and place the tack coats in accordance with the requirements of section 401 of the AHTD Standard Specifications.

3.4 PLACING ACHM SURFACE COURSE

- A. Construction Methods: Section 410, AHTD Standard Specifications.
- B. Temperature range of mix:
 - 1. When discharged from mixer: 285 degrees F. to 325 degrees F.
 - 2. When placed on base course: 275 degrees F. 325 degrees F.
- C. Temperature of air: Do not place ACHM when air temperature in the shade is below 40 degrees F.
- D. Place asphalt pavement to compacted depth shown on Drawing.
- E. Compact to required density, with approved rolling equipment. Start compaction as soon as pavement will bear equipment without checking or undue displacement.
- F. Required density: 92 percent of maximum theoretical density.
- G. Carry out compaction in three operations in pass sequence. Ensure each pass of roller overlaps previous passes to ensure smooth surface free of roller marks. Keep roller wheels sufficiently moist so as not to pick up material.
- H. Perform hand tamping in areas not accessible to rolling equipment.
- I. Ensure joints made during paving operations and at connection to existing pavement are straight, clean vertical and free of broken or loose material.
- J. Ensure surface of completed asphalt pavement is true to lines, profiles and elevations indicated, and is free from depressions exceeding 1/4 inch when measured with a 10 foot straight-edge.
- K. Do not allow vehicular traffic on newly paved areas until surface has cooled to atmospheric temperature.

3.5 FIELD QUALITY CONTROL

- A. Testing laboratory will make in-place tests of density and moisture content of the subgrade and the base course in accordance with ASTM D 2922-78.
- B. Testing laboratory will make density tests of compacted asphalt paving in accordance with ASTM D 107-76.

END OF SECTION

SECTION 32 13 13

PORTLAND CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

1.2 Section Includes

1. Preparation and placement of Portland cement concrete parking areas.
2. Preparation and placement of Portland cement concrete roads and entrances.

1.3 Related Sections

1. Section 312000 - Earthwork
2. Section 321206 - Base Course
3. Section 321313 - Pavement Markings

1.4 REFERENCES

A. American Concrete Institute (ACI)

1. ACI 301 -Structural Concrete for Buildings.
2. ACI 305R - Hot Weather Concreting
3. ACI 306R - Standard Specification for Cold Weather Concreting
4. ACI 308 - Standard Practice for Curing Concrete

B. American Society for Testing and Materials (ASTM)

1. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
2. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement
3. ASTM C 31 - Test Methods of Making and Curing Concrete Test Specimens in the Field.
4. ASTM C33 - Concrete Aggregates
5. ASTM C 39 - Test Method for Comprehensive Strength of Cylindrical Concrete Specimens.
6. ASTM C42 - Obtaining And Testing Drilled Cores And Sawed Beams Of Concrete
7. ASTM C94 - Ready-Mixed Concrete
8. ASTM C 138 - Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
9. ASTM C143 - Method for Slump of Hydraulic Cement Concrete
10. ASTM C150 - Portland Cement
11. ASTM C 172 - Method of Sampling Freshly Mixed Concrete.
12. ASTM C231 - Air-Content of Freshly Mixed Concrete by the Pressure Method
13. ASTM C260 - Air-Entraining Admixtures for Concrete
14. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete
15. ASTM C920 - Standard Specification for Elastomeric Joint Sealants
16. ASTM C1064 - Temperature Of Freshly Mixed Portland Concrete Cement
17. ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous)
18. ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
19. ASTM D2628 - Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

C. Federal Specifications (FS)

1. FS HH-F-341 - Fillers, Expansion Joint: Bituminous (Asphalt & Tar)

D. State Highway Department Standard Specifications

1.5 QUALITY ASSURANCE

- A. Establish and maintain required lines and elevations.
- B. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable paving as directed by Owner.

1.6 SUBMITTALS

- A. Submit certified laboratory test data or manufacturer's certificates and data for the items listed below certifying that materials are in conformance requirements specified herein. Submit to the Engineering Consultant of Record and the Independent Testing Laboratory for review and approval and within 7 calendar days after receipt of Notice-to-Proceed.
 - 1. Portland cement concrete mix
 - 2. Aggregate gradations
 - 3. Preformed expansion joint filler
 - 4. Field molded/poured sealant
 - 5. Dowel bars
 - 6. Expansion sleeves
 - 7. Tie bars
 - 8. Reinforcing steel bars
 - 9. Welded wire fabric
 - 10. Air entraining admixtures
 - 11. Water-reducing and set-retarding admixtures (if used)
- B. Submit certification that joint sealant has been installed in accordance with the manufacturer's instructions. Include copy of written instructions.

1.7 PROJECT CONDITIONS

- A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete: Mix concrete and deliver in accordance with ASTM C94.
 - 1. Design mix shall produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce following:
 - a. Compressive Strength: 4,000 psi, minimum at 28 days, unless otherwise indicated on Construction Drawings.
 - b. Slump Range: 1"-3" for hand placed concrete, 1-1/4" to 3" for machine placed (slipform) concrete
 - c. Air Entrainment: 5 to 7 percent
- B. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Coat forms with nonstaining type of coating that will not discolor or deface surface of concrete.

- C. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A185. Furnish in flat sheets.
- D. Reinforcing Bars: Deformed steel bars, ASTM A615, Grade 60.
- E. Portland Cement: ASTM C150, Type I
- F. Joint Fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D994, D1751, D2628; FS HH-F-341, Type II, Class A.
- G. Joint Sealants: ASTM C920, non-priming, pourable, self-leveling polyurethane.
 - 1. Acceptable sealants include Sonneborn "SL1", Sonneborn "SL2", Sonneborn "Sonomeric 1", Sonneborn "Sonomeric 2", Mameco "Vulkem 245", or Woodmont Products "Chem-Caulk".
- H. Aggregate: ASTM C33.
- I. Water: Clean and potable
- J. Dowel Bars: ASTM A615, grade 60, and plain steel bars.
- K. Air Entraining Mixture: ASTM C260, Sika AER by Sika Corporation or Air Mix by the Euclid Chemical Corporation.
- L. Curing Compound: ASTM C309, Hydrocide by Sonneborn of Rexnord Chemical Products, Inc. or Polyseal 4 in 1 by Chem Masters Corporation.
- M. Joint Backup Rods: CCEVA Rod 100 by E-Poxy Industrials, Inc., or Sealtight BACKER ROPE by W.R. Meadows, Inc.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Proofroll prepared base material surface to check for unstable areas in accordance with Section 312000 including documentation and re-proof rolling as required. Paving work shall begin only after unsuitable areas have been corrected and are ready to receive paving.
- B. Remove loose material from compacted base material surface to produce firm, smooth surface immediately before placing concrete.

3.2 INSTALLATION

- A. Form Construction
 - 1. Set forms to required grades and lines, rigidly braced and secured.
 - 2. Install sufficient quantity of forms to allow continuance of work and so that forms remain in place minimum of 24 hours after concrete placement.
 - 3. Check completed formwork for grade and alignment to following tolerances:
 - a. Top of forms not more than 1/8-inch in 10'-0".
 - b. Vertical face on longitudinal axis, not more than 1/4-inch in 10'-0".
 - 4. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.

- B. Reinforcement: Fasten reinforcing bars or welded wire fabric (if required) accurately and securely in place with suitable supports and ties. Remove from reinforcement all dirt, oil, loose mill scale, rust, and other substances that will prevent proper bonding of the concrete to the reinforcement.
- C. Concrete Placement
1. Concrete may be mixed and placed when the air temperature in the shade and away from artificial heat is a minimum of 35 degrees F and rising. Hot and cold weather concreting shall be in accordance with ACI 305R and 306R, respectively.
 2. Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Concrete shall not be placed around manholes or other structures until they are at required finish elevation and alignment.
 3. Place concrete using methods that prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
 4. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place construction joint.
- D. Joint Construction: Construct expansion, weakened-plane control (contraction), and construction joints straight with face perpendicular to concrete surface. Construct transverse joints perpendicular to centerline, unless otherwise detailed.
1. Weakened-Plane Control or Contraction Joints: Provide joints at spacing of 15'-0" on centers, maximum each way. Construct control joints for depth equal to at least 1/4 of the concrete thickness, as follows:
 - a. Form tooled joints in fresh concrete by grooving top with recommended tool and finishing edge with jointer.
 - b. Form sawed joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.
 2. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for period of more than 1/2 hour, except where such placements terminate at expansion joints. Construct joints in accordance with standard details.
 3. Transverse Expansion Joints: Locate expansion joints at maximum of 180'-0" on centers, maximum each way unless otherwise shown on the Construction Drawings. Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, sidewalks, and other fixed objects.
 4. Butt Joints: For joints against existing pavement, place 16" long dowels eight inches into holes drilled into center of existing slab. Epoxy dowels into holes with approved epoxy compound. Place dowels prior to concrete placement for new concrete. Dowel spacing to be 24" on center unless otherwise shown on Construction Drawings. Saw joint and fill with joint sealer.
- E. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than 1/2-inch or more than 1-inch below finished surface where joint sealer is indicated. Furnish joint fillers in 1-piece lengths for full width being placed, wherever possible. Where more than 1 length is required, lace or clip joint filler sections together.
- F. Joint Sealants: Joints shall be sealed with approved exterior pavement joint sealants and shall be installed in accordance with manufacturer's recommendations.

3.3 CONCRETE FINISHING

- A. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities and refloat repaired areas to provide continuous smooth finish.
- B. Work edges of slabs and formed joints with edging tool, rounding edge to 1/2-inch radius. Eliminate tool marks on concrete surface. After completion of floating and troweling, when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
 - 1. Inclined Slab Surfaces: Provide coarse, nonslip finish by scoring surface with stiff-bristled broom perpendicular to flow of traffic so as to produce regular corrugations not over 1/16 of an inch deep.
 - 2. Paving: Provide coarse, nonslip finish by scoring surface with stiff-bristled broom perpendicular to flow of traffic so as to produce regular corrugations not over 1/16 of an inch deep.
- C. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Owner.
- D. Protect and cure finished concrete paving using either membrane curing compound or moist-curing methods described in "water-curing" section of ACI 308.

3.4 CLEANING AND ADJUSTING

- A. The Contractor shall certify in writing that placement is in accordance with specification requirements.
- B. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.
- C. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.

3.5 FIELD QUALITY CONTROL

- A. Field quality control tests specified herein will be conducted by the Contractor's Independent Testing Laboratory at no cost to the Owner in accordance with Section 01458. The Contractor shall perform additional testing as considered necessary by the Contractor for assurance of quality control. Retesting required as a result of failed initial tests shall be at the Contractor's expense.
- B. Field testing, frequency, and methods may vary as determined by and between the Contractor and the Contractor's Testing Laboratory.
- C. Review the Contractor's proposed materials and mix design for conformance with specifications.
- D. Perform testing in accordance with ACI 301 and testing standards listed herein.
- E. Strength Tests:
 - 1. Secure composite samples in accordance with ASTM C 172. Sample at regularly spaced intervals from middle portion of the batch. Sampling time shall not exceed 15 minutes.
 - 2. Mold and cure specimens in accordance with ASTM C 31.

- a. A minimum of four concrete test cylinders shall be taken for every 100 cubic yards or less of each class of concrete placed each day and not less than once for each 5000 square feet of paved area.
 - b. During the initial 24 hours (plus or minus 8 hours) after molding, the temperature immediately adjacent to the specimens shall be maintained in the range of 60 to 80 degrees F. Control loss of moisture from the specimens by shielding from the direct rays of the sun and from radiant heating devices.
 - c. Specimens transported prior to 48 hours after molding shall not be demolded, but shall continue initial curing at 60 to 80 degrees F until time for transporting.
 - d. Specimens transported after 48 hours age shall be demolded in 24 hours (plus or minus 8 hours). Curing shall then be continued but in saturated limewater at 73.4 degrees (plus or minus 3 degrees F) until the time of transporting.
 - e. Wet cure cylinders under controlled temperature until testing.
3. Test cylinders in accordance with ASTM C 39.
- a. Date test cylinders and number consecutively. Give each cylinder of each set an identifying letter (i.e. A, B, C, D). Prepare a sketch of the building plan for each test set identifying location of placed concrete.
 - b. Test one cylinder (A) at 7 days for information. If the compressive strength of the concrete sample is equal to or above the 28 day specified strength, test another cylinder (B) at 7 days. The average of the breaks shall constitute the compressive strength of the concrete sample.
 - c. Test two cylinders (B and C) at 28 days and the average of the breaks shall constitute the compressive strength of the concrete sample.
 - d. Retain fourth cylinder (D) for further testing if needed, but do not retain cylinder more than 60 days.
4. Evaluation and Acceptance:
- a. Strength level of concrete will be considered satisfactory if the average of all sets of three consecutive strength tests equal or exceed specified strength and no individual strength test (average of two cylinders) results are below specified compressive strength by more than 500 psi.
 - b. Complete concrete work will not be accepted unless requirements of ACI 301, have been met, including dimensional tolerances, appearance, and strength of structure.
 - c. Where average strength of cylinders, as shown by tests is not satisfactory, Owner reserves the right to require Contractor to provide improved curing conditions of temperature and moisture to secure required strength. If average strength of laboratory control cylinders should fall so low as to cause portions of structure to be in question by Owner, follow core procedure set forth in ASTM C42. If results of core test indicate, in opinion of Owner, that strength of structure is inadequate, provide without additional cost to Owner, replacement, load testing, or strengthening as may be ordered by Owner. If core tests are so ordered and results of such tests disclose that strength of structure is as required, cost of test will be paid by Owner.
- F. Slump Test: Conduct slump test for each cylinder set taken in accordance with ASTM C 143. Make additional slump tests for every other load from a stationary mixer or truck to test consistency. Sampling shall be in accordance with ASTM C 172.
- G. Air Content: Conduct air content test for each cylinder set for concrete exposed to freeze-thaw in accordance with ASTM C 231, ASTM C 173, or ASTM C 138. Indicate test method on report. Make test at same time as slump test.
- H. Unit Weight: ASTM C 138.

- I. Temperature Test: Conduct temperature test for each cylinder set taken in accordance with ASTM C 1064. Test hourly when air temperature is 40 F and below or 80 F and above. Determine temperature of concrete sample and ambient air for each strength test.

- J. In addition to required information noted previously in this Section, record the following information on concrete compression reports:
 - 1. Test cylinder number and letter.
 - 2. Specific foundations or structures covered by this test.
 - 3. Proportions of concrete mix or mix identification.
 - 4. Maximum size coarse aggregate.
 - 5. Specified compressive strength.
 - 6. Tested compressive strength.
 - 7. Slump, air-content (when applicable) and concrete temperature.
 - 8. Concrete plastic unit weight.
 - 9. Concrete Temperature.
 - 10. Elapsed time from batching at plant to discharge from delivery truck at project.
 - 11. Date and time concrete was placed.
 - 12. Ambient temperature, wind speed, and relative humidity during concrete placement.
 - 13. Name of technician securing samples.
 - 14. Curing conditions for concrete strength test specimens (field and laboratory).
 - 15. Date strength specimens transported to laboratory.
 - 16. Age of strength specimens when tested.
 - 17. Type of fracture during test.

- K. At the start of each day's mixing, report any significant deviations from approved mix design including temperature, moisture and condition of aggregate.

- L. Certify each delivery ticket of concrete. Report type of concrete delivered, amount of water added and time at which cement and aggregate were loaded into truck, and time at which concrete was discharged from truck

- M. In Place Pavement Testing: The Contractor's Independent Testing Laboratory will randomly core pavement at minimum rate of 1 core per 20,000 sq. ft of pavement, with minimum of 3 cores from heavy-duty areas and 3 cores from light duty areas. Cores will be sampled and tested in accordance with ASTM C 42. Core will be tested for thickness and quality of aggregate distribution. Core holes shall be patched by the Contractor immediately with Portland cement concrete and shall be finished to provide level surface as specified herein.

- N. Additional Tests: Additional in-place tests shall be conducted as directed by the Owner when specified concrete strengths and other characteristics have not been attained in the structures.

END OF SECTION

SECTION 32 13 23

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

1.2 Section Includes

1. Painting and marking of pavements, curbs, guard posts, and light pole bases.

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation (AASHTO)

1. AASHTO M248 - Ready-Mixed White and Yellow Traffic Paints

B. American Society for Testing and Materials (ASTM)

1. ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness by Notched Gauges.

C. Federal Specifications (FS)

1. FS A-A-2886 - Paint, Traffic, Solvent Based (supersedes FS TT-P-85 and FS TT-P-115, Type I)
2. FS TT-P-1952 - Paint, Traffic And Airfield Marking, Waterborne

1.4 PROJECT CONDITIONS

- A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize flagmen, barricades, warning signs, and warning lights as required.

1.4 QUALITY ASSURANCE

- B. Use trained and experienced personnel in applying the products and operating the equipment required for properly performed work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Paint shall be waterborne or solvent borne, colors as shown or specified herein. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.
- B. Waterborne Paint: Paints shall conform to FS TT-P-1952.
- C. Solvent Borne Paint: Paint shall conform to FS A-A-2883 or AASHTO M248. Paint shall be non-bleeding, quick-drying, and alkyd petroleum base paint suitable for traffic-bearing surface and be mixed in accordance with manufacture's instructions before application for colors White, Yellow, Blue, and Red.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the work area and correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Sweep and clean surface to eliminate loose material and dust.
- B. Where existing pavement markings are indicated on Construction Drawings to be removed or would interfere with adhesion of new paint, a motorized abrasive device shall be used to remove the markings. Equipment employed shall not damage existing paving or create surfaces hazardous to vehicle or pedestrian traffic. Within public rights-of-way, appropriate governing authority shall approve method of marking removal.
- C. New pavement surfaces shall be allowed to cure for not less than 30 days before application of marking materials.

3.3 CLEANING EXISTING PAVEMENT MARKINGS

- A. In general, markings shall not be placed over existing pavement marking patterns. Existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns, shall be removed. Deteriorated or obscured markings that are not misleading or confusing or do not interfere with the adhesion of the new marking material do not require removal. Whenever grinding, scraping, sandblasting or other operations are performed, the work shall be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.4 APPLICATION

- A. Apply two coats of paint at manufacturer's recommended rate, without addition of thinner, with maximum of 100 square feet per gallon or as required to provide a minimum wet film thickness of 15 mils and dry film thickness of 7 ½ mils per coat. Paint shall be applied for a total dry film thickness of 15 mils. Apply with mechanical equipment to produce uniform straight edges. At sidewalk curbs and crosswalks, use straightedge to ensure uniform, clean, and straight stripe.
- B. Install pavement markings according to manufacturer's recommended procedures for the specified material.
- C. Following items shall be painted with colors noted below:
 - 1. Pedestrian Crosswalks: White
 - 2. Exterior Sidewalk Curbs, Light Pole Bases, and Guard posts: Yellow
 - 3. Fire Lanes: Red or per local code
 - 4. Lane Striping where separating traffic moving in opposite directions: Yellow
 - 5. Lane Striping where separating traffic moving in the same direction: White
 - 6. ADA Symbols: Blue or per local code
 - 7. ADA parking space markings as shown on the drawings.
 - 8. Parking Stall Striping: Yellow, unless otherwise noted on Construction Drawings

3.5 FIELD QUALITY CONTROL

- A. Inspection: After the paint has thoroughly dried, visually inspect the entire application and touch up as required to provide clean, straight lines and surfaces throughout.
- B. Testing: Testing of wet film thickness shall be performed a minimum of two times on each parking row (including striped islands) and pedestrian cross walks, and a minimum of one test on each lane/alignment striping. At least one test shall be performed after refilling paint striping machine, changing operators of striping machine, and changing paint types, brands, etc. This shall be performed in addition to the testing stated above. These tests shall be performed on each coat applied. Testing shall be performed in accordance with ASTM D4414.

3.6 CLEANING

- A. Waste materials shall be removed at the end of each workday. Upon completion of the work, all containers and debris shall be removed from the site. Paint spots upon adjacent surfaces shall be carefully removed by approved procedures that will not damage the surfaces and the entire job left clean and acceptable.

END OF SECTION

SECTION 32 13 33

CURBS AND SIDEWALKS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Portland cement concrete curb, gutter, and sidewalk.
- B. Related Sections
 - 1. Section 312000 - Earthwork

1.2 REFERENCES

- A. American Concrete Institute (ACI)
 - 1. ACI 305R - Hot Weather Concreting
 - 2. ACI 306R - Standard Specification for Cold Weather Concreting
 - 3. ACI 308 - Standard Practice for Curing Concrete
- B. American Standards for Testing and Materials (ASTM) latest edition
 - 1. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
 - 2. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement
 - 3. ASTM C94 - Ready-Mixed Concrete
 - 4. ASTM C260 - Air-Entraining Admixtures for Concrete
 - 5. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete
 - 6. ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous)
 - 7. ASTM D1190 - Concrete Joint Sealer, Hot Poured, Elastic Type
 - 8. ASTM D1751 - Performed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
 - 9. ASTM D2628 - Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
- C. Federal Specifications (FS)
 - 1. FS HH-F-341 - Fillers, Expansion Joint: Bituminous (Asphalt & Tar)
- D. State Highway Department Standard Specifications

1.3 SUBMITTALS

- A. Submit materials certificate from materials producer and Contractor, certifying that materials comply with, or exceed requirements specified herein to the Engineering Consultant of Record and the Independent Testing Laboratory for review and approval and within 7 calendar days after receipt of Notice-to-Proceed, submit for approval, certified laboratory test data or manufacturers certificates and data for the following items:
 - 1. Portland cement concrete mix
 - 2. Aggregate gradations
 - 3. Preformed expansion joint filler
 - 4. Field molded/poured sealant
 - 5. Dowel bars
 - 6. Expansion sleeves
 - 7. Tie bars

8. Reinforcing steel bars
9. Welded wire fabric
10. Air entraining admixtures
11. Water-reducing and set-retarding admixtures (if used)

1.4 QUALITY ASSURANCE

- A. Establish and maintain required lines and elevations.
- B. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable work as directed by Owner.

1.5 PROJECT CONDITIONS

- A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete: Mix concrete and deliver in accordance with ASTM C94.
 1. Design mix shall produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce following:
 - a. Compressive Strength: 4,000 psi, minimum at 28 days, unless otherwise indicated on Construction Drawings.
 - b. Slump Range: 1"-3" for hand placed concrete, 1-1/4" to 3" for machine placed (slipform) concrete
 - c. Air Entrainment: 5 to 7 percent
- B. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Forms shall be of depth equal to depth of curbing or sidewalk, and so designed as to permit secure fastening together at tops. Coat forms with nonstaining type of coating that will not discolor or deface surface of concrete.
- C. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A 185. Furnish in flat sheets.
- D. Reinforcing Steel: Deformed steel bars, ASTM A 615, Grade 60.
- E. Portland Cement: Shall conform to ASTM C150, Type I
- F. Joint Fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D994, D1751, D2628; FS HH-F-341, Type II, Class A or approved equal.
- G. Joint Sealants: Conforming to ASTM D1190, non-priming, pourable, self-leveling polyurethane. Acceptable sealants are Sonneborn "Sonolastic Paving Joint Sealant", Sonneborn "Sonomeric CT 1 Sealant", Sonneborn "Sonomeric CT 2 Sealant", Mameco "Vulken 245", or Woodmont Products "Chem-Caulk".
- H. Aggregate: ASTM C33.

- I. Water: Clean and potable
- J. Dowel Bars: ASTM A615, grade 60, and plain steel bars.
- K. Air Entraining Mixture: ASTM C260; Sika AER by Sika Corporation or Air Mix by the Euclid Chemical Corporation.
- L. Curing Compound: ASTM C309; Hydrocide by Sonneborn of Rexnord Chemical Products, Inc. or and Polyseal 4 in 1 by Chem Masters Corporation.
- M. Joint Backup Rods: CCEVA Rod 100 by E-Poxy Industrials, Inc., Sealtight BACKER ROPE by W.R. Meadows, Inc. or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Begin paving work only after unsuitable areas have been corrected and are ready to receive paving.
- B. Remove loose material from compacted base material surface to produce firm, smooth surface immediately before placing concrete.

3.2 INSTALLATION

A. Form Construction

1. Set forms to required grades and lines, rigidly braced and secured.
2. Install sufficient quantity of forms to allow continuance of work and so that forms remain in place minimum of 24 hours after concrete placement.
3. Check completed formwork for grade and alignment to following tolerances:
 - a. Top of forms not more than 1/8-inch in 10'-0".
 - b. Vertical face on longitudinal axis, not more than 1/4-inch in 10'-0".
4. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.

- B. Reinforcement: Fasten reinforcing bars or welded wire fabric (if required) accurately and securely in place with suitable supports and ties. Remove from reinforcement all dirt, oil, loose mill scale, rust, and other substances that will prevent proper bonding of the concrete to the reinforcement.

C. Concrete Placement

1. Concrete shall be mixed and placed when the air temperature in the shade and away from artificial heat is a minimum of 35 degrees F and rising. Hot and cold weather concreting shall be in accordance with ACI 305R and 306R, respectively.
2. Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until set at required finish elevation and alignment.
3. Place concrete using methods that prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
4. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place construction joint. Automatic machine may be

used for curb and gutter placement. Machine placement shall be at required cross section, line, grade, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified herein.

D. Joint Construction

1. Contraction Joints: Construct concrete curb or combination concrete curb and gutter, where specified on Construction Drawings, in uniform sections of length specified on Construction Drawings. Form joints between sections either by steel templates, 1/8-inch in thickness, of length equal to width of curb and gutter, and with depth which will penetrate at least 2-inches below surface of curb and gutter; or with 3/4-inch thick performed expansion joint filler cut to exact cross section of curb and gutter; or by sawing to depth of at least 2-inches while concrete is between 4 and 24 hours old. If steel templates are used, they shall be left in place until concrete has set enough to hold it's shape, but shall be removed while forms are still in place.
2. Longitudinal Construction Joints: Tie concrete curb or combination concrete curb and gutter, where specified on Construction Drawings, to concrete pavement with 1/2-inch round deformed reinforcement bars of length and spacing shown on Construction Drawings.
3. Transverse Expansion Joints: Concrete curb, combination concrete curb and gutter, or concrete sidewalk shall have filler cut to exact cross section of curb, gutter, or sidewalk. Joints shall be similar to type of expansion joint used in adjacent pavement.

E. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than 1/2-inch or more than 1-inch below finished surface where joint sealer is indicated. Furnish joint fillers in 1-piece lengths for full width being placed, wherever possible. Where more than 1 length is required, lace or clip joint filler sections together.

F. Joint Sealants: Install in accordance with manufacturer's recommendations.

3.3 CONCRETE FINISHING

- A. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide continuous smooth finish.
- B. Work edges of sidewalks, gutters, back top edge of curb, and formed joints with edging tool, rounding edge to 1/2-inch radius. Eliminate tool marks on concrete surface. After completion of floating and trowelling, when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
 1. Curbs, gutters, and sidewalks: Broom finish by drawing fine-hair broom across surface perpendicular to flow of traffic. Repeat operation as necessary to produce fine line texture.
- C. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up minor honeycombed areas. Remove and replace areas or sections with major defects as directed Owner.
- D. Protect and cure finished concrete paving using acceptable moist-curing methods in accordance with "water-curing" section of ACI 308.

3.4 BACKFILL

- A. After concrete has set sufficiently, spaces on either side of concrete curb, combination concrete curb and gutter, or concrete sidewalk shall be refilled to required elevation with suitable material compacted in accordance with Section 312000.

3.5 CLEANING AND PROTECTION

- A. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.
- B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.

END OF SECTION

SECTION 32 83 00

SITE SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Traffic control signs.
 - 2. Site signs.

1.2 REFERENCES

- A. American Standard for Testing Materials (ASTM)
 - 1. ASTM C94 - Ready Mix Concrete
- B. US Department of Transportation, Federal Highway Administration
 - 1. Manual on Uniform Traffic Control Devices (MUTCD).

PART 2 - PRODUCTS

2.1 SIGNS: All signs will be furnished and installed by the Contractor. Conform to the following and MUTCD classification is shown in parentheses:

- A. "STOP" Signs: 30-inches x 30-inches, Octagon, white legend and border on red background (R1-1)
- B. "YIELD" Signs: 36-inches x 36-inches x 36-inches, Triangle, red legend and border band with white interior (R1-2)
- C. "SPEED LIMIT 10MPH" Signs: 12-inches x 18-inches, black legend and border on white background (R2-1)
- D. "NO RIGHT TURN" (or "NO LEFT TURN") Signs: 24-inches x 24-inches, black legend and border, red circle and bar, and white background (R3-1 and R3-2)
- E. "RIGHT TURN ONLY" (or "LEFT TURN ONLY") Signs: 30-inches x 36-inches, black legend and border on white background (R3-5)
- F. "DO NOT ENTER" Signs: 30-inches x 30-inches, white legend, bar, and background and red circle (R5-1)
- G. "NO TRUCKS" Signs: 24-inches x 24-inches, black truck symbol, red circle and bar, on white background (R5-2)
- H. "ACCESSIBLE PARKING SYMBOL" Signs: 18-inches x 24-inches, green legend and border, white symbol on blue box, and white background (R7-8)
- I. "PED XING" Signs: 30-inches x 30-inches, black legend and border on yellow background (W11-2)
- J. Miscellaneous Signs: See Construction Drawings

2.2 POSTS

- A. 2" diameter galvanized steel pipe with galvanized sign-mounting hardware for each sign.

2.3 CONCRETE

- A. Mix concrete and deliver in accordance with ASTM C94.
- B. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce following:
 - 1. Compressive Strength: 3,500 psi, minimum at 28 days, unless otherwise indicated on Construction Drawings.
 - 2. Slump Range: 1 to 3-inches at time of placement
 - 3. Air Entrainment: 5 to 8 percent

PART 3 - EXECUTION

3.1 PREPARATION

- A. Contractor shall field verify underground utilities prior to sign installation. Primary utilities of concern of shallow depths are lawn sprinkler systems, electric, telephone, fiber optic, cable and gas.
- B. Cost related to repair of damaged surface and subsurface facilities shall be paid for by the Contractor at no additional expense to the Owner.

3.2 INSTALLATION

- A. Install posts in 12 inch diameter x 24 inch deep concrete foundations. Set posts vertical and plumb with bottom of sign at minimum 7'-0" above finish grade unless otherwise indicated on the Construction Drawings. Mount signs in accordance with manufacturer's instructions. Existing concrete shall be core-drilled as necessary.

END OF SECTION

SECTION 328400

LANDSCAPE IRRIGATION SYSTEM

PART 1-GENERAL

1.1 WORK INCLUDED

- A. Installation of automatic lawn and shrub sprinkler system providing uniform moisture coverage.
- B. Furnishing of materials and installation of a complete automatic lawn and shrub sprinkler system providing uniform moisture coverage. The work shall include all materials, equipment and labor required to complete the project as outlined in the project drawings, documents and this specification.
- C. Installation of backflow preventer, pressure regulator, irrigations lines (pressurized), automatic control valves, valve boxes, control and coming wiring, lateral lines, sprinkler heads, automatic controller as shown on the project drawings and irrigation plan.
- D. Excavation and Backfill.
- E. Tests including system pressure and performance test.
- F. Pipe and fittings.
- G. Sprinkler heads.
- H. Control system and connection to electrical supply.
- I. Trenching, installation of system and connection to water source; testing and backfilling.
- J. Sleeving.

1. Direct and coordinate with the General Contractor for desired sleeve locations and sizes. It is the responsibility of the Irrigation Contractor to do this otherwise the Irrigation Contractor is responsible for the irrigation sleeving.

1.2 RELATED WORK

- A. Section 329200 - Turf and Grasses
- B. Section 329300 – Planting

1.3 REFERENCES

- A. ANSI/ASTM D2564 – Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings.

- B. ASTM D2241 – Poly Vinyl Chloride (PVC) Plastic Pipe (SDR-PR).
- C. ASTM – American Society of Testing Materials
- D. AWWA – American Water Works Association
- E. NSF – National Sanitary Foundation
- F. NEC – National Electric Code

1.4 DESCRIPTION

- A. Electric solenoid controlled underground sprinkler system consisting of PVC plastic pipe and fittings, with fixed spray and variable arc rotary pop-up heads in a multi-station electric control system, programmed as approved by Owner.

1.5 SUBMITTALS

- A. Provide (3) copies of manufacturer's product data for each type of sprinkler head, swing joint assemblies, electric control valves, automatic and manual drain valves, isolation valves, valve boxes, pipe, fittings including tapping tees and saddles, control wire, waterproof wire connectors, irrigation controller, backflow preventer, booster pump and rain and freeze sensors proposed for use.
- B. Provide manufacturer's product data, each type of sprinkler head and valve proposed for use.
- C. Upon completion and final review of system by Owner, Contractor shall provide record or as-built drawings (reproducibles) of completed facilities as installed. Drawings shall be provided to contractor in a) electronic form (Autocad format) b) three (3) copies of the as-built drawing in or photocopy form and size. As-built drawings shall show the measured distance from easily identified, fixed locations to isolation valves, electric control valves, manual drain valves and wire splices.
- D. Upon completion and final review of system by Owner, Contractor shall provide three (3) binders containing manufacturer's installation, operation and maintenance instructions as well as a parts breakdown and catalog for each piece of equipment installed on the project. As a minimum the binders shall include information for the irrigation controller, booster pump, backflow preventer, pressure regulators, isolation valves, electric control valves, drain valves, air relief valves, all spray and rotary sprinkler heads, rain and freeze moisture sensors.
- E. Upon completion and final review of system by Owner, contractor shall provide a plastic laminated (sealed) reduced drawing of the irrigation system indicating the area or zones of the irrigation system controlled by each electric control valve. For clarity, drawing may be divided into two sections and shown on both sides of the laminated sheet. Reduced drawings shall be placed on the inside of the controller door. Drawing shall be approved for clarity by Contractor prior to acceptance of system.

1.6 OPERATION/MAINTENANCE DATA AND DEMONSTRATION

- A. Provide instructions for operation and maintenance of system and controls, and manufacturer's parts catalog.
- B. Provide schedule indicating length of time each valve is required to be open to provide determined amount of water.
- C. Provide a recommended schedule for runt times and frequency of watering for the first two weeks, the first two months and the first twelve months (including all seasonal change requirements) after completion of the installation.

1.7 EXTRA STOCK

- A. Provide the following extra stock items:
 - 1. Two sprinkler heads of each type and size.
 - 2. Two valve keys for manual valves.
 - 3. Two keys for valve markers.
 - 4. Two wrenches for each type head core and for removing and installing each type head.
 - 5. Two couplers for each size of quick coupling valve.

1.8 SYSTEM SERVICE

- A. Inspect system at two and four weeks after Date of Substantial Completion and make necessary adjustments.

1.9 WARRANTY

- A. Entire sprinkler system will be unconditionally guaranteed against defects in material and workmanship, including repair of settling of backfilled areas below grade and adjusting heads to proper level for a period of one year from Date of Substantial Completion.
- B. Minor adjustments, any defective electrical controls, valves, sprinkler heads or other working parts will be repaired or replaced without cost to the Owner for a period of one year from the date of acceptance.
- C. Damage by others during the one-year guarantee period will be Owner's responsibility.
- D. Warrant sprinkler system to have 100 percent uniform moisture coverage of areas shown to be sprinkled.

PART 2 – PRODUCTS

2.1 MATERIALS – GENERAL

- A. The specified materials to be used shall be as designated on the contract drawings and this specification. All materials to be incorporated in this work shall be new and of the best quality, meeting the requirements for such materials and for the purposes intended. The irrigation lines on the contract drawings are diagrammatic. The Contractor shall be responsible for computing and supplying the required pipe, fittings, control wires and electrical accessories required to complete the project.
- B. Acceptable Manufacturers
 - 1. Hunter or Rain Bird or approved equal. Equipment may be mixed.
- C. Substitutions: All material shall be supplied and installed according to this specification and the specifications of the equipment and material manufacturers. Should contractor desire to substitute materials or equipment other than that described in this specification, the following procedures shall be followed:
 - 1. Provide manufacturer's specification for the proposed equipment and show how it is equal or better than the specified equipment.
 - 2. Demonstrate, if required by Owner, the actual performance of the equipment.
 - 3. Receive, from Owner, written approval for the proposed substitutions.
- D. Material Storage: A specific area shall be provided in which all materials to be used on the project shall be stored when not in use. Provision of this land is for the purpose of keeping the property neat and orderly and in no way waives any requirements of the Contractor to protect his equipment and materials from damage by the elements, from theft or from vandalism.

2.2 PIPE AND FITTING MATERIALS

- A. Pressurized Main Line Pipe: All 2 ½" and smaller main line pipe shall meet the latest requirements of ASTM D 1785 Standard Specification for Schedule 40 Poly (vinyl chloride) PVC pipe with size as shown on the project drawings. Solvent-weld sockets.

All main line pipe to be installed in curved sleeves shall be copper, Type L Soft and shall be the size required to meet the requirements of this specification. All transition fittings to PVC shall be copper sweat socket with threaded MIPT or FIPT connections to the PVC main line pipe.
- B. Lateral Pipe: All lateral pipe, downstream of the control valves, shall have solvent weld joints and shall meet the latest requirements of ASTM D 2241 Standard Specification for Poly (vinyl chloride)(PVC) Plastic Pipe with standard dimension ratio (SDR) of 21 and a Pressure Rating (PR) of 200 PSI.
- C. Sleeving Pipe: All sleeving (straight sections) to protect pipe or control wires at roads, sidewalks or below grade crossings shall be PVC Schedule 40. All sleeves (curved sections) to protect pipe or control wires at sidewalks and below grade crossing shall be high-density polyethylene with a working pressure of 160 psi. Sleeves shall be a minimum of two (2) times the diameter of the crossing pipe or that shown on the project drawings. Minimum sleeve size shall be 2" diameter. All irrigation control wires shall be routed in a separate sleeve with a minimum diameter of 2".

D. Fittings:

1. Tees attaching the electric control valves and quick coupling valves onto the mainline (2 ½" and smaller) shall be PVC Schedule 80 solvent welded or threaded fittings and shall meet ASTM D 2467 and ASTM D 2464 respectively. PVC Schedule 80 fittings and nipples shall be used on all fittings required between the mainline tap and the electric control valve as well as the threaded connection between the electric control valve and the lateral piping. Schedule 80 fittings shall be Spears Manufacturing or approved equal. Contract shall use manufacturer's recommended sealing compounds and/or Teflon tape according to manufacturer's recommended practice for the specific application.

Mainline fittings (2 ½" and smaller) at all points of direction change such as 22.5, 45, tees, or 90 degree turns shall be solvent weld with a minimum of Schedule 40 dimensions and shall meeting requirements of ASTM Specification D 2466-78. Schedule 40 fittings shall be Spears Manufacturing or approved equal.

Fittings for gasket-joint PVC pipe, for all directional changes, pipe reductions and plugs shall be deep bell push-on gasket joint ductile iron fittings for PVC pipe. Fittings shall be manufactured of ductile iron, grade 70-55-05 in accord with ASTM A536 and gaskets shall meet ASTM F477. Fittings shall be as manufactured by Harrington Corporation, Harco, or equal. For main line pipe to zone valve/lateral pipe connections, Harco or equal push-on gasket joint ductile iron service tees or ductile iron saddles. Ductile iron saddles shall be equal to Harco Ductile Iron Saddles as manufactured by Harrington Corporation. The saddles shall provide full support around the circumference of the pipe and an O'ring seal shall be provided so that there is no gap between the installed saddle and pipe and hydraulic pressure will complete the seal.

2. Lateral Line Fittings – Solvent welded fittings shall be Schedule 40 dimensions and wall thickness and shall meet the requirements of ASTM Specification D 2466 and shall be used on all piping downstream of electric control valves.
3. Solvent Cement: ANSI/ASTM D2564 for PVC pipe and fittings.
4. All ½" inlet spray heads shall be connected to the irrigation piping utilizing ½" thick walled polyethylene tubing (Rain Bird Model SPX-100) and appropriate insert fittings (Rain Bird Models SBE-050, SBE-075, SBA-050, SBA-075). Sufficient lengths of flexible pipe shall be used to form a sweeping arc to insure that spray heads are supported properly and allow for vertical adjustment and movement during service.
5. Any quick coupling valves shall be installed on prefabricated, manufactured swing joint assembly rated for 315 psi with pre-lubricated buttress threads and O'rings seals equal to Spears Manufacturing Co. Series 5807-01012.

- E. Swing Joints: Prefabricated, schedule 80 PVC, equal to Spears. Use for ground level pop-up impact driven heads, gear-driven rotary heads, hydrant and quick-coupler valves.

2.3 SPRINKLER HEADS AND NOZZLES

- A. Sizes and types noted on Drawing(s).

2.4 VALVES

- A. Automatic Control Valves: Remote, electrically operated, normally closed, diaphragm globe valves. The valve shall have a 200 psi CWP rating. Flow control stem shall be non-rising. The valve cover shall be secured to the body with stainless steel threaded studs and nuts. Bleeding of water during manual operations shall be either internal or external. Control valves shall be contamination resistant, glass filled high strength nylon body and bonnet. Sizes and types as indicated on Drawings(s).
- B. Isolation Valve for the Electric Control Valve: Ball type, plastic construction, with threaded ends. Valves shall have a maximum pressure rating of 235 psi at 73 degrees F. The valves shall be equal to Spears Model 2131-OXX sized the same as the control valve.
- C. Gate Valves (Isolation Shut off Valves): 2 ½" and smaller – shall be bronze, threaded, screw-in bonnet with non-rising stem rated for a 125 psi WSP and 200 psi non-shock WOG. The valve shall be domestic manufacture, shall meet Federal Specifications MSS SP-80 equal to Hammond Model IB645.
- D. Automatic Drain Valves: Equal to King Technology, Inc. Model 22, ½" inlet.
- E. Manual Drain Valve: Bronze body, angle type 150 psi class, with cross-type operating handle designed to receive a valve operating key.
- F. Backflow Preventer: Provide a Reduced Pressure Backflow Preventer for irrigation system use located adjacent to the irrigation water meter. RPZ to be housed in fiberglass enclosure on concrete base.

2.5 WATER METER

- A. The Irrigation Contractor is responsible for setting the meter. Comply with local codes for installation requirements and permitting. Contractor to provide meter, and obtain permits and inspection.

2.6 CONTROLLER

- A. Type noted on Drawing(s), including fittings and accessories.

2.7 VALVE BOXES AND MARKERS

- A. For Automatic Control Valves: Equal to Carson Industries Inc. model 1419-3 with 1419-6X extensions as required.
- B. For Manual Drain Valve: Equal to Carson Industries, Inc. model 910-10 w/corrugated plastic pipe for extension.

1. For Quick Coupling Valves: Equal to Carson Industries Inc. model 1419-3 with 1419-6X extensions as required.
 - C. For Above Grade Backflow Preventers In Exterior Locations: Fiberglass enclosure equal to "Hot Box" manufactured by Northeast Florida Enterprises, Inc. 1/800-736-0238. Place on concrete slab and anchor with 4 bolts. Size to fit backflow preventer. Provide electrical connection and heater or heater cable as recommended by enclosure manufacturer.
- 2.8. CONTROL VALVE WIRING
- A. Wire: Type AWG-1UF, bearing U.S. approval, minimum 14 gauge. One common wire, No. 12 UF is required for each controller, or as required for the Hunter ACC-99D controller. Provide all grounding as required by manufacturer.
 - B. Splicing Materials: Sta-Kon no. P7-70 connector and Scotchlok no. 3576 sealing pack. Scotchcote sealer for splices, or as required for the Hunter ACC-99D controller.
- 2.9 ENVIRONMENT CONDITION SENSEORS
- A. Rain Sensor – Equal to WSS manufactured by Hunter
 - B. Freeze Sensor- Equal to WSS manufactured by Hunter

PART 3 – EXECUTION

3.1 PREPARATION

- A. Head locations and pipe routing are diagrammatic only and shall be adjusted during installation to compensate for prevailing winds, gradient, and landscaping to insure proper coverage with minimal overthrow.

3.2 TRENCHING

- A. Trench for sprinkler system to provide proper grades and slopes to drain points.
- B. Keep trenches free of debris, material or other obstructions that may damage pipe.

3.3 INSTALLATION

- A. Install sleeves under paving and other improvements prior to construction. Install where required to accommodate piping at proper depth to prevent damage by other construction activities and to provide specified burial depth for irrigation pipe. Location of sleeves to be recorded and marked.

- B. Install pipe, valves, controls and sprinklers in accordance with manufacturer's instructions. Connect to water and electrical service. All work to be accomplished in accordance with applicable codes.
- C. All main line piping to be installed will a minimum of 18 inches cover and lateral piping with 12 inches minimum cover. Bed pipe on solid base free from rocks and other deleterious materials.
- D. Set sprinkler heads and valve box covers at finish grade. Valve boxes shall be placed in groundcover areas where possible. Rectangular valve boxes to be placed parallel to nearby curbs and walks or other improvements.
- E. Provide for thermal movement.
- F. Install automatic drain valves at all low sections of lateral piping (lines downstream from valves) to insure complete drainage of system when not in use. Wrap each valve with approved filter fabric.
- G. Install manual drain valves at all low sections to mainline (upstream lines) piping to permit complete drainage of system when not in use. Provide 12-inch depth gravel sump below each valve.
- H. Install all heads on approved swing-joints or nipple connections as shown on Drawings.
- I. Spray nozzles in shrub or other planting bed to be installed on risers of specified materials unless otherwise noted. Height of riser to be sufficient to provide complete coverage and allow for 1 to 2 years of plant growth.
- J. Install subsurface drip in locations indicated on plans and in accordance with manufacturer's recommendations. All such tubing to be completely concealed from view by covering with mulch.
- K. Install control wiring:
 - 1. Place the excess wire in a 10 inch expansion coil at each valve to which controls are connected and at 100 foot intervals. Control wiring may be installed in the same trenches with the irrigation piping. Wiring shall be bundled and taped with electrical tape at 10 foot intervals the entire length of each run. Wiring shall be installed on the north or east side of the pipes. Wire shall not be taut in the trench and expansion loops shall be provided to prevent the wire from being tensioned by backfilling or other subsequent construction. The side of the trench in which the wires are located shall be free of stones and other hard material which might injure the wire insulation. Backfill material placed against the wires shall be select material especially free from stones or other material which might injure the insulation.

A minimum of 24" wire for an expansion loop shall be allowed at each valve for contraction of wire or tightening of wire due to back-filling of trenches or possible valve services or replacement.

Splices outside of valve locations are not allowed. All connections at the electric control valves shall be water-proofed with the system in Section 2.08 "Wiring".

2. Install four (4) additional control wires from the controller to the furthest points along the main line with two wires on each side of the main. Terminate the wires with waterproof connections at the furthest valve-box location from the controller and note location on the as-built drawing.
- L. After piping is installed, before sprinkler heads are installed and backfilling commences, open valves and flush system with full head of water.
- M. Backfill trench and compact to finish grade elevation. Fill material placed within 12 inch of pipe to contain no rock or gravel particles greater than ½ inch in diameter. Protect piping from displacement. All settlement after backfill to be repaired.
- N. Arrange and coordinate installation of water meter.
- O. Provide concrete thrust blocks at changes in direction (at ells and tees) of mains and at termination of mains. One cubic foot minimum. Size of blocks and location to be in strict accordance with pipe manufacturer's specifications. Size shall be adequate and so placed to take all thrust created by maximum internal water pressure.
- P. Set valve box covers level at finish grade. Rectangular valve boxes to be placed parallel to nearby curbs and walks or other improvements. Valves and valve boxes shall be installed where shown or directed, and shall be set plumb. Valve boxes shall be centered on the valves. Where feasible, valves shall be located outside the area of natural walkways or paths and shall be placed in groundcover areas where possible. Earth fill shall be carefully tamped around each valve box. Valve boxes should be supported or blocked such that any surface loads on the valve boxes will not be transmitted below to the pipe or valves. Washed gravel sumps shall be provided below all valve boxes to permit drainage of water away from valves. Minimum depth of gravel sump is 8 inches.
- Q. Install at least two (2) automatic drain valves per zone at all low points sections of lateral piping (lines downstream from valves) to insure complete drainage of system when not in use.
- R. All sprinklers shall be installed on flexible connections or swing joints as specified in Section 2.2 "Pipe and Fitting Materials" and shall be set plumb and level with the final turf grade.
- S. All trenches shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand, soft shale, or other approved materials, free from large clods or earth or stone. Rock, broken concrete or pavement, and large boulders shall not be used as backfill material. The backfill shall be thoroughly compacted and evened off with the adjacent soil level. Selected fill dirt or sand shall be used if soil conditions are as discussed above. The fill dirt or sand shall be used in filling four (4) inches above the pipe. The remainder of the backfill shall contain no lumps or rocks larger than one (1) inch. The top six (6) inches of backfill shall be free of rocks or gravel particles over one-half (1/2) inch in diameter, subsoil or trash. Open trenches or partially backfilled trenches shall be kept to a minimum and effort shall be made to completely backfill that trench opened each day. The Contractor will be responsible for restoration of all settlement for a period of one year from acceptance.

- T. The irrigation controller shall be mounted inside the specified cabinet securely, level and plumb at the specified location shown on the contract drawings according to manufacturer's recommendations. Electrical conduit PVC sweep ells shall be used for the entering and exiting of the 24 volt control wires into the conduit entering the controller. Controllers shall be connected to the appropriate valves as indicated on the contract drawings. Electrical power supply to the controller shall be installed according to local electrical codes and shall be provide contractor.
- U. Rain and freeze sensors shall be installed according to manufacturer's recommendations and shall be installed at locations approved by Owner.
- V. Clean area and remove all debris and excess materials from site.
- W. Install pre-fabricated enclosure over backflow preventer. Place on 4" thick concrete pad sized to accommodate attachment per manufacturer's requirements. Provide electrical connection and install heater or heat cable.

3.4 TESTS

A. Static Pressure Test

1. The entire main line system shall be constructed to successfully withstand, when completed, a full static pressure of 100 psi (whichever is greater) for a period of 6 hours with no resulting flow or pressure loss.
2. The testing for leakage shall be conducted with the observation of the Owner and all pipe, joints and appurtenances will be inspected while the system is under test pressure and leaks corrected as directed. The testing shall extend over a period of up to six (6) hours to allow for a complete inspection.

B. Performance Test

1. Upon completion of the irrigation system installation including all pressure tests, Contractor shall conduct a performance test of the complete system to insure that all components are functioning properly. Performance test shall consist of operating the system through a complete irrigation cycle per day for two (2) consecutive days. Contractor shall be at the site to monitor the performance tests and make any adjustments and corrections as needed during the testing period.
2. The Contractor shall balance and adjust the various components of the system so that overall operation of the system is most efficient. This includes adjustment to pressure regulators, part-circle sprinkler heads and individual station adjustments on the controllers.
3. Repair grades and re-dress mulch in planted areas disturbed by final testing and adjustment.

END OF SECTION 328400

SECTION 329300

PLANTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Plants
 - 2. Planting soils
 - 3. Tree Stabilization
 - 4. Landscaping edgings

1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than sized indicated; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated.
- D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.
- E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 type and size of plant.

- G. Finish Grade: Elevation of finished surface of planting soil.
- H. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- I. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- J. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- K. Planting Area: Areas to be planted.
- L. Planting Soil: Standardized topsoil; native surface topsoil; in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. Topsoil to be free of rocks and debris and free of noxious weeds.
- M. Plant; Plants; Plant Material: Test terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- N. Root Flare: Also called “trunk flare”. The area at the base of the plant’s stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- O. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- P. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- Q. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- R. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil be subsoil.

1.4 SUBMITTALS

- A. Product Date: For each type of product indicated, including soils.
 - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials as well as clear photograph’s of plant material samples indicated for Landscape Architect’s acceptance.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.
 - 1. Experience: Five (5) years' experience in landscape installation.
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 3. Pesticide Applicator: State licensed, commercial.

- C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
 - 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
 - 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

- D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 - 1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

- E. Preinstallation Conference: Conduct conference at Project site if required for this project.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened contains showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

- 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 fertilizers and soil amendments with appropriate certificates.

- C. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- E. Handle planting stock by root ball.
- F. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
 - 1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
 - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-what condition.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Interruption of Existing Services of Utilities: Do not interrupt services or utilities to facilities occupied by Owner or other unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
 - 1. Notify Landscape Architect no fewer than two days in advance of proposed interruption of each service or utility.
 - 2. Do not proceed with interruption of services or utilities without Landscape Architect's written permission.
- C. 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 and warranty requirements.

- D. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.8 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within one year after Substantial Completion.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization, edgings.
 - d. Deterioration of metals, metal finishes, and over materials beyond normal weathering.
 - 2. Warranty Periods from Date of Substantial Completion:
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months
 - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
 - c. Annuals: Two months.
 - 3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each plant will be required except for loses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for period equal to original warranty period, for replacement plant material.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: Until all items on the punch list are complete or until final acceptance by owner.
- B. Initial Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
1. Maintenance Period: Until all items on the punch list are complete or until final acceptance by owner.

PART 2 – PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem, form shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk (“included bark”); crossing trunks; cut-off limbs more than $\frac{3}{4}$ inch in diameter; or with stem girdling roots will be rejected.
 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.
- E. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

- F. Annuals: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to side of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 - 1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
 - 2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
 - 3. Provide lime in form of ground dolomitic limestone.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: Horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through ¾-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.

2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- B. Sphagnum Peat: partially decomposed sphagnum peat moss, finely divided or granular texture, with a pH range of 3.4 to 4.8.
 - C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finally divided or of granular texture, with pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.
 - D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
 1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.
 - E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of four (4) percent nitrogen and ten (10) percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast-and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Composition: 1lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amount recommended in soil reports from a qualified soil-testing laboratory.
- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

- E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
 - 1. Size: 10-gram tablets
 - 2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.
- F. Chleated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.5 PLANTING SOILS

- A. Planting Soil: ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones and other extraneous materials harmful to plant growth. Mix ASTM D 5268 topsoil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
 - 1. Ratio of Loose Compost to Topsoil by Volume: 1.4.

2.6 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 - 1. Type: shredded pine bark.
 - 2. Size Range: 3 inches maximum, ½ inch minimum.
 - 3. Color: Natural.
- B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content to 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content on 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.
 - 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- C. Mineral Mulch:
 - 1. ¾-1" washed river gravel. Minimum 2" deep installed over weed barrier fabric.

2.7 PESTICIDES

- A. General: Pesticide registered and approved by 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 authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination of growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.8 TREE STABILIZATION MATERIALS

- A. Stakes and Guys:
 - 1. Guying: ARBORGUY PRO 40 Tree Anchoring System, install per manufacturer's recommendations.

2.9 LANDSCAPE EDGINGS

- A. Steel Edging: Standard commercial-steel edging, rolled edge, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.
 - 1. Manufacturer:
 - a. Pro-Steel or Col Met
 - 2. Edging Size: 3/16 inch wide by 4 inches deep. (Non aluminum)
 - 3. Stakes: Tapered steels a minimum of 12 inches long.
 - 4. Accessories: Standard tapered ends, corners, and splicers.
 - 5. Finish: Standard paint.
 - 6. Paint Color: Green.

2.10 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Burlap: Non-sythetic, biodegradable.

PART 3- EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
 - 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. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 - 3. Suspend soil spreading, grading, and tiling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable and which is too 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 Landscape Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants 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.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply fertilizer directly to subgrade before loosening.

2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
 3. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting area if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
1. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
 2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 6. Maintain supervision of excavations during working hours.
 7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
 8. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Subsoil and topsoil removed from excavations may be used as planting soil.

- C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
 - 1. Hardpan Layer: Drill 6-inch diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining materials.
- D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
 - 1. Use planting soil for backfill.
 - 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during plant operation.
 - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
 - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Set container-grown stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
 - 1. Use planting soil for backfill.
 - 2. Carefully remove root ball from container without damaging root ball or plant.
 - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets in each planting pit when pit is approximately one-half-filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root about 1 inch from root tips; do not place tablets in bottom of the hole.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- E. Set fabric bag-grown stock plumb and in center of planting pit or trench with root flare 1-inch above adjacent finish grades.
1. Use planting soil for backfill.
 2. Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- F. Set and support bare-root stock in center of planting pit or trench with root flare 1 inch above adjacent finish grade.
1. Use planting soil for backfill.
 2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots.
 3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1-inch from root tips; do not place tablets in bottom of the hole or touching the roots.
 4. Continue backfilling process. Water again after placing and tamping final layer of soil.
- G. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Landscape Architect.

- C. Prune, thin and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

3.7 TREE STABILIZATION

- A. Install trunk stabilization as follows unless otherwise indicated:
 - 1. Upright Staking and Tying: Stake trees of 2-through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend one-third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
 - 2. Use two stakes for trees up to 12 feet height and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
 - 3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
 - 4. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
- B. Staking and Guying: Stake and guy trees more than 14 feet in height and more than 3 inches in caliper unless otherwise indicated. Securely attach no fewer than three guys to stakes 30 inches long, driven to grade.
 - 1. Site-Fabricated Staking-and-Guying Method:
 - a. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle for each guy wire and tighten securely.
 - b. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 - c. Support trees with strands of cable or multiple strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 - d. Attach flags to each guy wire, 30 inches above finish grade.
 - e. Paint turnbuckles with luminescent white paint.
 - 2. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.8 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, take care not to cover plant crowns with wet soil.
- G. Protect plans from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 36-inch radius around trunks or stems.
 - 2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades.

3.10 EDGING INSTALLATION

- A. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches apart, driven below top elevation of edging.

3.11 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.12 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.13 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protected during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.14 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 329300

SECTION 330800

SEWER MANHOLES, FRAMES, AND COVERS

GENERAL

1.1 SUMMARY

1.2 Section Includes

1. Monolithic concrete, modular precast concrete, masonry, and precast polyethylene manhole assemblies.

1.3 Related Sections

1. Section 031200 - Earthwork. Excavation, backfill, and compaction
2. Section 334100 - Storm Drainage

1.4 REFERENCE STANDARDS

A.

1. ASTM A 48 - Gray Iron Castings
2. ASTM C 55 - Concrete Building Brick
3. ASTM C 478 - Precast Reinforced Concrete Manhole Sections
4. ASTM C 923 - Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
5. ASTM D 1248 - Polyethylene Plastics Molding and Extrusion Materials

B. International Masonry Industry All-Weather Council (IMIAC)

1. Recommended Practices and Guide Specification for Cold Weather Masonry Construction

C. State Department of Transportation (DOT), Construction and Material Specifications

1.5 SUBMITTALS

- A. Shop Drawings: Indicate reference to Construction Drawings of manhole locations, elevations, piping with sizes, locations, and elevations of penetrations.

- B. Product Data: Provide data for manhole covers, component construction, features, configuration, and dimensions.

PART 2 - PRODUCTS

2.1 MANHOLES

- A. Cast-In-Place Concrete: Nonreinforced cast in place concrete barrel.

1. Concrete: 3500 psi concrete
2. Forms: Steel sheet accurately shaped and fabricated of sufficient strength to form dense watertight walls to true dimensions.

- B. Precast Concrete: Reinforced precast concrete barrel.

1. Manhole sections conforming to ASTM C 478 with gaskets in accordance with ASTM C 923.
2. Construct manholes of precast concrete sections as required by Construction Drawings to size, shape, and depth indicated.

- C. Concrete Brick: ASTM C 55, Grade N Type I-moisture controlled, normal weight, of same grade, type and weight as block units, nominal modular size of 3 5/8-inches x 7 5/8-inches x 2 1/4-inches
- D. Precast Polyethylene:
 - 1. Manufacturer: Advanced Drainage Systems (ADS) or approved equal.
 - 2. Precast polyethylene in accordance with ASTM D 1248. Nominal cylinder internal diameter shall be 48-inches and shall be designed to accept concrete filled polyethylene manhole lids and standard cast iron frames with lid or grate.
 - 3. Manholes shall have compressive strength that meets ASTM D 2412 standards.
- E. Mortar and Grout: Mortar for finishing and sealing shall be Class "C". Honeycombing less than 2-inches deep shall be repaired using Class "D" mortar.
- F. Brick Transition Reinforcement: Formed steel 8-gauge wire with galvanized finish.
- G. Configuration:
 - 1. Barrel Construction: Concentric with eccentric cone top section.
 - 2. Shape: Cylindrical
 - 3. Clear Inside Dimensions: 48-inches diameter minimum or as indicated on Construction Drawings.
 - 4. Design Depth: As indicated on Construction Drawings.
 - 5. Clear Lid Opening: 22-inches minimum
 - 6. Pipe Entry: Provide openings as indicated on Construction Drawings
 - 7. Main and Lateral Pipes: Neatly cut off main and lateral pipes flush with inside of manhole or inlet where they enter structure walls. Point up irregularities and rough edges with nonshrinking grout.
- H. Inverts: Shape inverts for smooth flow across structure floor as indicated on Construction Drawings. Use concrete and mortar to obtain proper grade and contour. Finish surface with fine textured wood float.

2.2 COMPONENTS

- A. Lid and Frame:
 - 1. Manufacturer: Neenah Foundry Company, East Jordan Iron Works, or approved equal.
 - 2. ASTM A 48, Class 30B heavy duty cast iron construction, machined flat bearing surface.
 - 3. Removable lid, closed or open as indicated on Construction Drawings, sealing gasket.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify items specified by other Sections are properly sized and located.
- B. Verify that built-in items are in proper location and ready for roughing into work.
- C. Verify that the excavation for manholes is correct.

3.2 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves as indicated on Construction Drawings.

3.3 PRECAST MANHOLE CONSTRUCTION

- A. Place base pad to proper elevation and location and trowel top surface level for placement of manhole barrel.
- B. Place manhole barrel plumb and level to correct elevations and anchor to base pad.
 - 1. After completion of slab foundation, lower first joint of manhole barrel into position, grooved end first, and set level and plumb on concrete base. Align and adjust to proper grade prior to placing and forming invert. Pour invert immediately after setting of first section of manhole barrel.
 - 2. Prior to setting subsequent manhole barrel sections, apply primer to tongue and groove ends and allow to set in accordance with manufacturer's recommendations. Place "Ram-nek", or equivalent, plastic rope on tongue end. Lower next section into position, and remove excess material from interior of structure. Add additional material on exterior of joint, if necessary, for completely watertight joint.
- C. Set cover frames and lids level without tipping, to correct elevations. Utilize pre-cast rings or brick and mortar to achieve final rim elevation. Maximum limit, 4 courses.

3.4 CAST-IN-PLACE MANHOLE CONSTRUCTION

- A. Cast-in-place shall conform to the applicable requirements. Utilize steel forms.
- B. Place base pad to proper elevation and location and pour monolithically with invert. Base shall support pipe to first joint.
- C. Deposit concrete in evenly distributed layers of about 18 inches, with each layer vibrated to bond to preceding layer.
- D. Place gasket between all joints and paint exterior of manhole within 5' of the joint with mastic waterproofing.
- E. Place precast concrete cone.
- F. Set section cover frames and lids level without tipping, to correct elevations. Utilize pre-cast rings or brick and mortar to achieve final rim elevation. Maximum limit, 4 courses.

3.5 MASONRY MANHOLE CONSTRUCTION

- A. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- B. Lay masonry units in running bond. Course 3 brick units and 3 mortar joints to equal 8 inches.
- C. Form flush mortar joints
- D. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- E. Install joint reinforcement 16 inches on center
- F. Place joint reinforcement in first and second horizontal joints above base pad and below lid frame opening

- G. As work progresses, build in fabricated metal items
- H. Cut and fit masonry for pipes as specified herein
- I. Set cover frames and covers level to correct elevations without tipping.

3.6 TESTING

A. General:

1. All sanitary sewer manholes shall be inspected and tested tested for water tightness or damage prior to acceptance by the owner and engineer. If a manhole fails the test, the Contractor shall locate the leak and make proper repairs and re-test. The owner or engineer reserves the right to refuse leaking manholes, in which case the Contractor will replace the manhole at his expense.

END OF SECTION

SECTION 33 41 00

STORM DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Storm sewer drainage piping, fittings, and accessories.
2. Storm drainage structures.

1.2 Related Requirements

1. Section 312000 - Earthwork
2. Section 312800 - Erosion and Sedimentation Control
3. Section 033000 - Cast-In-Place Concrete

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M36 - Zinc Coated (Galvanized) Corrugated Iron or Steel Culverts and Under Drains
2. AASHTO M190 - Bituminous Coated Corrugated Metal Culvert Pipe and Arches
3. AASHTO M252 - Corrugated Polyethylene Drainage Tubing, 3 to 10 Inch Diameter
4. AASHTO M294 - Corrugated Polyethylene Drainage Tubing, 12 to 48 Inch Diameter
5. AASHTO MP7-97 - Corrugated Polyethylene Drainage Tubing, 54 to 60 Inch Diameter
6. AASHTO M198 - Joints for Circular Sewer and Culvert Pipe Using Flexible Watertight Gaskets
7. AASHTO H170 – Reinforced Concrete Culvert, Storm Drain and Sewer Pipe

B. American Society for Testing and Materials (ASTM)

1. ASTM A74 - Cast Iron Soil Pipe and Fittings
2. ASTM A185 - Steel welded Wire Fabric, Plain, for Concrete Reinforcement
3. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
4. ASTM A746 - Ductile Iron Gravity Sewer Pipe
5. ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
6. ASTM C150 - Portland Cement
7. ASTM C206 - Finished Hydrated Lime
8. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
9. ASTM C564 - Rubber Gasket for Cast Iron Soil Pipe and Fittings
10. ASTM C969 - Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
11. ASTM D3034 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
12. ASTM D3212 - Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
13. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe
14. ASTM F949 – Poly (Vinyl Chloride)(PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings

C. American Concrete Institute (ACI)

1. ACI301 - Structural Concrete for Buildings

1.4 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, and accessories. Provide shop drawings for precast inlets, catch basins and junction boxes.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified local requirements.
- C. Project Record Documents
 1. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.
 2. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

1.5 PROJECT CONDITIONS

- A. Coordinate work with termination of storm sewer connection outside building including connection to municipal storm sewer system.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Reinforced Concrete Pipe (RCP): ASTM C76, Class III unless noted otherwise on Drawings, installed with flexible plastic, bitumen gaskets at joints.
 1. Gaskets: AASHTO M 198 751, Type B or ASTM C 443, installed in accordance with manufacturer's recommendations.
 2. Flared end sections shall be per ASTM C76 or AASHTO H170 (for sections with toe wall)
- B. High Density Polyethylene Pipe (HDPE): AASHTO Designation M252 Type S, M294 Type S and MP7-97 Type S, smooth interior/annular exterior. Only permitted when specifically indicated on Drawings. Pipe shall be installed in accordance with pipe manufacturer's installation Guidelines for Culvert Storm Drainage Applications.
 1. Pipe Joints and fittings shall conform to AASHTO M252 and M294.
 2. Acceptable manufacturers: Advanced Drainage Systems, Inc. "ADS N-12", HANCOR, INC. "Hi-Q", or approved equal.
- C. Spiral Rib Metal Pipe: ASTM A 760 Type 1R or Type IIR. Coatings shall meet requirements of ASTM A929 and shall be galvanized, aluminized, or bituminous coated as specified on Drawings. Only permitted when specifically indicated on Drawings.
 1. Pipe ends shall be re-corrugated and installed with semi-corrugated "Hugger" type bands and "O" ring gaskets in accordance with pipe manufacturer's installation requirements.
 2. Pipe gauge shall be as specified on construction drawings or if no gauge is given then the minimum gauges are as follows: 15" to 42" diameter round pipe – 16 gauge (0.064"), 48" to 60" round pipe – 14 gauge (0.079"), 66" to 78" round pipe – 12 gauge (0.109"), 15" to 30" pipe arch – 16 gauge (0.064"), 36" to 42" pipe arch – 14 gauge (0.079"), and 48" to 78" pipe arch – 12 gauge (0.109"). Gauges for larger diameters shall be indicated on the drawings.
 3. Installation shall be in accordance with ASTM A798 and A796 as they apply, manufacturer's requirements, and as indicated on the drawings.
 4. Standard corrugated steel pipe as described in section E of these specifications shall not be substituted for any diameter of Spiral Rib Steel Pipe.
 5. Manufacturer: Contech, Inc. "Ultra Flo or Ultra Flo II", Southeast Culvert, Inc. "Max Flow", St. Regis Culvert, Inc. "Max Flow", Thompson Culvert, Inc. "Max Flow", or approved equal.

- D. Polyvinyl Chloride (PVC) Pipe: ASTM D3034, rated SDR 35 (or ASTM 949 for Profile Pipe) continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 3034 classification. Only permitted when specifically indicated on Drawings.
 - 1. Pipe joints: ASTM D 3212 using restrained gasket conforming to ASTM F477.

- E. Corrugated Steel (Metal) Pipe (CSP or CMP): ASTM A 760, 16 gauge unless another gauge is indicated on Drawings. Galvanized, aluminized (Type 1R), or bituminous coated as specified on Drawings. Only permitted when specifically indicated on Drawings. Corrugated steel pipe may be round pipe, arch pipe, or slotted drainpipe as indicated on Drawings. Slotted drainpipe shall have 1.75-inches wide drain waterway openings and 6 inches minimum height drain guide
 - 1. CSP, bands and appurtenances shall be uniformly coated inside and outside with a 0.05 inch minimum thickness bituminous coating in accordance with AASHTO M190. .
 - 2. CSP shall be supplied with paved inverts or fully lined to provide a smooth interior, smooth flow lining only as indicated on the drawings.

- F. Ductile Iron Pipe (DIP): ASTM A746
 - 1. Fittings: Cast iron conforming to ASTM A74
 - 2. Joint Material: Rubber gasket conforming to the requirements of ASTM C564 for compression joints.

- G. Subdrains: Perforated, PVC or flexible corrugated plastic pipe as specified herein of the size indicated on the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with bedding material.
- B. Remove large stones or other hard matter that could damage piping or impede consistent backfilling or compaction.
- C. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

3.3 INSTALLATION - PIPE

- A. The pipe shall be inspected for defects and cracks before being lowered into the trench, piece by piece. Any defective, damaged or unsound pipe or any pipe that has had its grade disturbed after laying shall be taken up and replaced. Open ends shall be protected with a stopper to prevent earth or other material from entering the pipe during construction. The interior of the pipe shall be free from dirt, excess water and other foreign materials as the pipe laying progresses and left clean at the completion of the installation.

- B. Excavate pipe trench and place bedding material in accordance with Section 312000.
- C. Installation shall commence at the lowest point for each segment of the route. RCP shall be laid with the groove or bell end upstream. Riveted CSP shall be placed with the inside circumferential laps pointing downstream. Repair damaged bituminous coating on CSP by applying bituminous material conforming to AASHTO M190.
- D. Lay pipe to the required line and slope gradients with the necessary fittings, bends, manhole, risers and other appurtenances placed at the required location as noted on Drawings.
- E. Do not displace or damage pipe when compacting.
- F. No pipe shall be laid in water or when trench conditions are unsuitable for such work.
- G. Joints:
 1. Joints shall be constructed as described herein and in accordance with manufacturer's installation instructions with the intent that they be made watertight.
 2. For RCP, the joint surface shall be cleaned and washed with water, if necessary, before the joints are made. For tongue and groove joints in smaller sizes, make joints butting the inside of the bell with a cement mortar before joining. The inside joint shall be wiped clean of excess mortar by brush or a squeegee drawn through the pipe as the laying operations progress. In the larger diameters, which permit the entry of a man, annular space between pipe sections shall be completely filled with mortar and finished off smooth with the inside surface of the pipe.
 3. CSP shall be joined by standard corrugated connecting bands. Keep dirt or gravel out from between the pipes and band so that corrugations fit snugly. While being tightened, the bands shall be tapped with a mallet to take up slack and insure a tight joint.
 4. PVC fittings shall be attached to the pipe by solvent welding according to the manufacturer's recommendations.

3.4 SUBDRAINS

- A. Subdrains shall be installed in accordance with the details and at the locations shown on the drawings

3.5 INSPECTION AND TESTING

- A. General
 1. Storm sewer systems and culverts, upon completion or at such time as directed, shall be cleaned, inspected and tested. The system or culvert shall have a true grade and line. Actual elevations shall be within 0.08 feet of the elevations given on the drawings.
 2. After completion of the Work, or any part thereof, the job shall be tested to determine that it has been installed in accordance with the drawings and specifications. In general, the Work shall prove to be in good condition, installed in accordance with the drawings and specifications and ready for use.
- B. Cleaning and Testing
 1. Visibly inspect and remove all debris and obstructions from storm pipe. Test for infiltration and exfiltration by hydrostatic testing per ASTM C969. Manholes and pipe shall conform to ASTM C969 leakage criteria.
- C. Alignment Test

1. After backfill has been placed and compacted to a depth not less than one foot above top of pipe, a visual inspection shall be made by flashing a light between manholes. Any displacement or misalignment of invert shall be corrected.

END OF SECTION