PROJECT MANUAL

Santa Fe County
Extension Office Addition & Remodel
3229 Rodeo Road
Santa Fe, NM 87507
BID SUBMITTAL
February 1, 2017

COVER SHEET

Architect:
Scott C. Anderson & Associates Architects
Scott C. Anderson, Principal

[Signature]

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END SECTION 00010
DOCUMENT 003132 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

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

B. Soil-boring data for Project, obtained by GeoTest, dated 12/6/16, is available for viewing as appended to this Document.

C. A geotechnical investigation report for Project, prepared by GeoTest dated 12/15/16, is available for viewing as appended to this Document.

D. Related Requirements:
   1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.
   2. Document 003119 "Existing Condition Information" for information about existing conditions that is made available to bidders.
   3. Document 003126 "Existing Hazardous Material Information" for hazardous materials reports that are made available to bidders.

END OF DOCUMENT 003132
GEOTECHNICAL ENGINEERING SERVICES
JOB NO. 1-61106
4-H BUILDING ADDITIONS
3229 RODEO ROAD
SANTA FE, NEW MEXICO

PREPARED FOR

SCOTT C. ANDERSON & ASSOCIATES ARCHITECTS
December 15, 2016
Job No. 1-61106

Scott C. Anderson & Associates Architects
7604 Rio Peñasco NW
Albuquerque, New Mexico 87120

ATTN: Mr. Scott C. Anderson, AIA, Principal

RE: Geotechnical Engineering Services
4-H Building Additions
3229 Rodeo Road
Santa Fe, New Mexico

Dear Mr. Anderson:

Submitted herein is the Geotechnical Engineering Services Report for the above referenced project. The report contains the results of our field investigation, laboratory testing, and recommendations for foundation, slab support, as well as criteria for site grading.

It has been a pleasure to serve you on this project. If you should have any questions, please contact this office.

Respectfully submitted: Reviewed by:

GEO-TEST, INC.

Timothy Matson
Engineering Geologist

cc: Addressee
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INTRODUCTION

This report presents the results of the geotechnical engineering services investigation performed for the proposed addition to the 4-H building located at 3229 Rodeo Road in Santa Fe, New Mexico.

The objectives of this investigation were to:

1) Evaluate the nature and engineering properties of the subsurface soils underlying the site.

2) Provide recommendations for foundation design, slab support, as well as criteria for site grading.

The investigation includes subsurface exploration, selected soil sampling, laboratory testing of the samples, performing an engineering analysis and preparation of this report.

PROPOSED CONSTRUCTION

It is understood that the project consists of a single story, 1,500 square foot addition to the north side of the existing structure as well as a portal to the south and west side of the building. No basements are planned and concrete slabs will be cast on-grade. Structural loads are unknown at this time but are anticipated to be relatively light, not exceeding 50 kips on columns and 3 kips per linear foot on bearing walls.

Should structural loads or other project details vary significantly from those outlined above, this firm should be notified for review and revision of recommendations contained herein.

FIELD EXPLORATION

Two exploratory borings were drilled to approximately 16 feet below existing site grade. The locations of the borings are shown on the attached Boring Location Map, Figure 1. During the test drilling, the soils encountered in the borings were continuously examined, visually classified and logged. The boring logs are presented in a following section of this report. Drilling was accomplished by a truck mounted drill rig using 5½-inch diameter continuous flight hollow stem auger. Subsurface materials were sampled at five foot intervals or less utilizing an open tube split barrel sampler and a brass ring-lined sampler driven by a standard penetration test hammer.
LABORATORY TESTING

Selected soil samples were tested in the laboratory to determine certain engineering properties of the soils. Moisture contents and dry densities were determined to evaluate the various soil deposits with depth. The results of these tests are presented on the boring logs.

Sieve analysis and Atterberg limits tests were performed to aid in soil classification. In addition, a consolidation test was performed on selected sample to evaluate the volume change potential of the soils upon moisture increases. The results of these tests are presented in the Summary of Laboratory Results presented in a following section of this report.

SITE CONDITIONS

A brief site reconnaissance was performed during our site exploration. The addition will be located on the north side of the existing building and the portal will be located on the south and west sides of the building. The area for the addition is relatively flat, sloping very gently to the west northwest. The area is landscaped with trees and bushes. From the outside, the existing CMU building appeared to be in relatively good condition; however, was missing a downspout from the roof on the northeast corner of the building. Also, some of the trees in the landscaped area were planted very close to the existing building.

SUBSURFACE SOIL CONDITIONS

As indicated by the exploratory borings, the soils underlying the site consist of a surface layer consisting of soft to firm sandy clays. These soils ranged from low to medium in plasticity and extended to about 6 feet below existing site grades. Directly below the clayey surficial soils, silty sand was encountered and extended to full depth explored. These soils were generally non-plastic and ranged from loose to medium dense.

No free groundwater was encountered in the borings and soil moisture contents were generally low to moderate in boring no. 1 and moderate to high in boring no. 2.

CONCLUSIONS AND RECOMMENDATIONS

Some of the near surface soils underlying the site are low in relative density. These soils have the potential to create excessive settlements of footings and floor slabs, particularly upon significant moisture increase. In addition,
some of these clayey soils are of medium plasticity and possess a low expansive potential. These soils could create excessive upward movements (heave) of shallow spread-type footings and slabs on-grade, particularly upon significant moisture increases. Moreover, due to the previous construction on the site, there is a potential that some loose and soft, man-made fill soils are present underlying at least some areas of the proposed building site. Accordingly, the existing, near surface native soils are not considered suitable in their present condition to provide reliable support of shallow footings and slabs on-grade.

However, with special site preparation and in order to create a uniform bearing surface, the proposed structure can be supported on shallow spread-type footings and slabs on-grade bearing directly on properly compacted structural fill. Site preparation would consist of overexcavation of a portion of the native soils, as well as any existing man-made fill, beneath the proposed additions. These materials should be overexcavated to such an extent as to provide for a minimum of 2.0 feet of properly compacted structural fill beneath all foundations and floor slabs. The structural fill should also extend laterally from the footing perimeters a distance equal to the depth of fill beneath their bases. Detailed recommendations concerning site preparation and foundation design are presented in the following sections of this report.

Post-construction moisture increases in the supporting soils could cause some differential foundation movements. Therefore, moisture protection is considered an important design consideration and should be reflected in overall site grading and drainage details as recommended in the Moisture Protection section of this report.

FOUNDATIONS

Shallow spread-type footings bearing directly on a minimum of 2.0 feet of properly compacted structural fill, is recommended for the support of the structure. An allowable soil bearing pressure of 2,000 pounds per square foot is recommended for footing design. This bearing pressure applies to full dead load plus realistic live loads, and can be safely increased by one-third for totals loads including wind and seismic forces.

Exterior footings should be established a minimum of 2.0 feet below lowest adjacent finished grade, while interior footings should be at least 12 inches below finished floor grade. The minimum recommended width of square and continuous footings is 2.0 and 1.33 feet, respectively.

Total settlements (or heave) of foundations designed and constructed as
recommended herein are estimated not to exceed ¾ inch for the soil moisture contents encountered during this investigation or moisture contents introduced during construction. Differential movements should be less than 75 percent of total movements. Significant post-construction moisture increases in the supporting soils could create additional movements, and thus, the moisture protection provisions as recommended in a following section of this report are considered important for the satisfactory performance of the structure.

**UPLIFT AND LATERAL FORCES**

It is anticipated that uplift forces may control foundation design of the portal. The shallow spread-type footings recommended above will also resist upward forces. The ultimate uplift resistance of spread-type footings should be considered equal to the weight of the concrete in the footing plus the weight of the soil contained in an inverted prism defined by lines extending upward and outward at an angle of 30 degrees from the top edges of the footings to the ground surface. A unit weight 120 pounds per cubic foot should be used for the weight of the soil when placed as structural fill as recommended in a following section of this report. A factor of safety of 2.0 should be used to calculate the allowable uplift capacity.

Resistance to lateral forces will be provided by soil friction between the base of the footings and the soil and by passive earth resistance against the sides of the footings. A coefficient of friction of 0.40 should be used for computing the lateral resistance between bases of footings and the soil. With backfill as recommended in the site grading section of this report, a passive soil resistance equivalent to a fluid weighing 325 pounds per cubic foot should be used for analysis.

**SLABS ON GRADE**

Adequate support for lightly loaded slab-on-grade floors will be provided by the structural fill when prepared as recommended in a following section of this report. Thus, the use of granular base for structural support of lightly loaded slabs is not considered necessary. However, should it be desired as a working surface, a course of granular base can be placed beneath concrete floor slabs.

Where granular base is used beneath the slabs, it should have a plasticity index of no greater than 3 and meet the following grading requirements:
The granular base should be compacted to at least 95 percent of maximum dry density as determined in accordance with ASTM D1557.

The granular base will act as a capillary barrier, but will not totally eliminate the rise of moisture to the slabs. If floor coverings are proposed which are highly sensitive to moisture, it is recommended the slab be placed in accordance with the procedures recommended by the American Concrete Institute (ACI 302.1R-04).

**SITE-GRADING**

The following general guidelines should be included in the project construction specifications to provide a basis for quality control during site grading. It is recommended that all structural fill and backfill be placed and compacted under engineering observation and in accordance with the following:

1) After site clearing and grubbing, existing native soils should be overexcavated to such an extent as to provide for a minimum thickness of 2.0 feet of properly compacted structural fill beneath all footings and floor slabs. The overexcavation limits should extend laterally beyond the perimeter of the footings a distance of 2.0 feet. Prior to placement of structural fill, the exposed native soils should be densified as outlined below.

2) Densification of the exposed native soils should consist of scarifying to a depth of 8 inches, moisture conditioning to the optimum moisture content or above and compacting the area to a minimum of 95 percent of maximum dry density as determined in accordance with ASTM D698.

3) The results of this investigation indicate that the sandy clay surface soils underlying the site will not be suitable for use as structural fill; however, may be blended with a more granular imported material to meet the specifications stated below. If this cannot be achieved, then import material will be required. All imported fill must also meet the
requirements for structural fill. All structural fill and backfill should be free of vegetation and debris, and contain no rocks larger than 3 inches. The gradation of the fill and backfill material, as determined in accordance with ASTM D-422, should be as follows:

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<td>No. 4</td>
<td>60 - 100</td>
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<tr>
<td>No. 200</td>
<td>20 - 60</td>
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4) The plasticity index of the structural fill should be no greater than 15 when tested in accordance with ASTM D-4318.

5) Fill or backfill, should be placed in 8-inch loose lifts and compacted with approved compaction equipment. Lifts should be reduced to 4-inches if hand held compaction equipment is used. Each lift should be firm and non-yielding.

7) All compaction of fill or backfill shall be accomplished to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D-1557. The moisture content of the fill or backfill, during compaction, should be within 2 percent of the optimum moisture content.

6) Tests for degree of compaction should be determined by the ASTM D-1556 method or ASTM D-6938. Observation and field tests should be carried on during fill and backfill placement by the geotechnical engineer to assist the contractor in obtaining the required degree of compaction. If less than 95 percent is indicated, additional compaction effort should be made with adjustment of the moisture content as necessary until 95 percent compaction is obtained.

CONSTRUCTION CONSIDERATIONS

Overexcavation immediately adjacent to the existing structure could result in undermining the existing footings. If this occurs, the existing building should be shored and no loss of ground should be allowed. As an alternate to shoring, segmental excavation may be attempted. The procedure would be to excavate from the bottom of the existing footings to the bottom of the excavation at a 1.5 horizontal to 1 vertical slope. The excavation can then be completed to the existing footing in maximum 8 foot segments. Adjacent
excavation should not be made until structural fill has been placed back up to the bottom of the existing footing.

**MOISTURE PROTECTION**

Precautions should be taken during and after construction to minimize moisture increase of foundation soils. Positive drainage should be established away from the exterior walls of the additions. A typical adequate slope is 6 inches in the first 5 feet with positive drainage being provided from those points to streets or natural water courses. If necessary to provide positive drainage, the building areas should be raised above adjacent grade with structural fill. Backfill should be well compacted and should meet the specifications outlined in the Site Grading section of this report. Irrigation within 10 feet of foundations should be carefully controlled. All utility trenches leading into the addition should be backfilled with compacted fill. Special care should be taken during installation of the subfloor sewer and water lines to reduce the possibility of future subsurface saturation.

Proper landscaping and drainage maintenance is required to preclude accumulation of excessive moisture in the soils below the additions. Accumulations of excessive moisture could be harmful to some types of interior flooring, to HVAC ductwork beneath the slabs, and can weaken or cause other changes in the soils supporting the foundations and slabs. This can cause differential movement of the foundations and can result in cosmetic or structural damage to the structures.

If any water line leaks or if irrigation system leaks are detected, they should be promptly repaired. And, if any depressions develop from the settlement of soils in utility trenches or other areas, they should be backfilled to maintain the grade so that surface water drains rapidly away from the structures.

The foregoing recommendations should only be considered minimum requirements for overall site development. It is recommended that a civil/drainage engineer be consulted more detailed grading and drainage recommendations.

**FOUNDATION REVIEW AND INSPECTION**

This report has been prepared to aid in the evaluation of this site and to assist in the design of this project. It is recommended that the geotechnical engineer be provided the opportunity to review the final design drawings and specifications in order to determine whether the recommendations in this report are applicable to the final design. Review of the final design drawings

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and specifications should be noted in writing by the geotechnical engineer.

In order to permit correlation between the conditions encountered during construction and to confirm recommendations presented herein, it is recommended that the geotechnical engineer be retained to perform continuous observations and testing during the earthwork portion of this project. Observation and testing should be performed during construction to confirm that suitable fill soils are placed upon competent materials and properly compacted and foundation elements penetrate the recommended soils.

**CLOSURE**

Our conclusions, recommendations and opinions presented herein are:

1) Based upon our evaluation and interpretation of the findings of the field and laboratory program.

2) Based upon an interpolation of soil conditions between and beyond the explorations.

3) Subject to confirmation of the conditions encountered during construction.

4) Based upon the assumption that sufficient observation will be provided during construction.

5) Prepared in accordance with generally accepted professional geotechnical engineering principles and practice.

This report has been prepared for the sole use of Scott C. Anderson & Associates Architects, specifically for the design of the proposed additions to the 4-H building in Santa Fe, New Mexico, and not for use by any third parties.

We make no other warranty, either express or implied. Any person using this report for bidding or construction purposes should perform such independent investigation as he deems necessary to satisfy himself as to the surface and subsurface conditions to be encountered and the procedures to be used in the performance of work on this project. If conditions encountered during construction appear to be different than indicated by this report, this office should be notified.
All soil samples will be discarded 60 days after the date of this report unless we receive a specific request to retain the samples for a longer period of time.
Figure 1

4-H Building Additions
3229 Rodeo Road, Santa Fe, New Mexico
Job No. 1-61106
**LOG OF TEST BORINGS**

**GROUNDWATER DEPTH**

**NO: 1**

**Project:** 4H Building Addition  
**Date:** 12/06/2016  
**Elevation:**  
**Type:** 5.5" OD HSA

**During Drilling:** none  
**After 24 Hours:**

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<tr>
<td>5</td>
<td>SS</td>
<td>3-5-9</td>
<td>10</td>
<td>CL</td>
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<tr>
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<td>SS</td>
<td>6-9-12</td>
<td>8</td>
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<tr>
<td>15</td>
<td>SS</td>
<td>7-11-9</td>
<td>5</td>
<td>SM</td>
<td>SILTY SAND, non-plastic, medium dense, slightly moist, brown</td>
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<tr>
<td>20</td>
<td>SS</td>
<td>5-9-12</td>
<td>6</td>
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<td>Stopped Auger @ 14.5 feet</td>
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**STYLE & MATERIALS**

- **SS** - Split Spoon
- **AC** - Auger Cuttings
- **UD/SL** - Undisturbed Sleeve
- **ST** - Shelby Tube
- **UD** - Undisturbed
- **CS** - Continuous Sampler
- **AMSL** - Above Mean Sea Level

**LEGEND**

Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.
**LOG OF TEST BORINGS**

**NO: 2**

**During Drilling: none**

**After 24 Hours:**

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>LOG SAMPLE INTERVAL</th>
<th>TYPE</th>
<th>N. BLOWS/FT</th>
<th>MOISTURE %</th>
<th>DRY DENSITY (pcf)</th>
<th>USC</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>5</td>
<td>UD</td>
<td>4-5</td>
<td>9</td>
<td>15</td>
<td>99</td>
<td>CL</td>
<td>SANDY CLAY, medium plasticity, soft to firm, moist, brown</td>
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<tr>
<td>5</td>
<td>SS</td>
<td>4-9-14</td>
<td>16</td>
<td>11</td>
<td>9</td>
<td>SM</td>
<td>SILTY SAND, non-plastic, loose, moist, brown</td>
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<tr>
<td>20</td>
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<td></td>
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<td></td>
<td></td>
<td>Stopped Auger @ 14.5 feet</td>
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<td></td>
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<td>Stopped Sampler @ 16 feet</td>
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**LEGEND**

- SS - Split Spoon
- AC - Auger Cuttings
- UD/SL - Undisturbed Sleeve
- AMSL - Above Mean Sea Level
- CS - Continuous Sampler
- UD - Undisturbed
- ST - Shelby Tube

Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.
# SUMMARY OF LABORATORY RESULTS

## Project: 4H Building Addition

**Location:** Santa Fe, NM  
**Number:** 1-61106

<table>
<thead>
<tr>
<th>TEST HOLE</th>
<th>DEPTH (FEET)</th>
<th>UNIFIED CLASS</th>
<th>(%) MOIST</th>
<th>LL</th>
<th>PI</th>
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<th>NO 100</th>
<th>NO 40</th>
<th>NO 10</th>
<th>NO 4</th>
<th>3/8&quot;</th>
<th>1/2&quot;</th>
<th>3/4&quot;</th>
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<th>1 1/2&quot;</th>
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</table>

**LL = LIQUID LIMIT**  
**PI = PLASTICITY INDEX**  
**NP = NON PLASTIC or NO VALUE**
Project: 4H Building Addition
Location: Santa Fe, NM
Number: 1-61106
CONSOLIDATION TEST RESULTS
4-H BUILDING ADDITION
SANTA FE, NEW MEXICO
PROJECT NO. 1-61106

CONSOLIDATION - PERCENT - SWELL
APPLIED LOAD (KSF)

SAMPLE INUNDATED AT 0.144 KSF

INITIAL MOISTURE CONTENT = 13.1%
INITIAL DRY DENSITY = 99.3 pcf
BORING #2 @ 2.5'
SECTION 011100 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. General description of work and Contractor’s duties
   2. Work by others.
   3. Work Sequence.
   4. Contractor use of site.
   5. Definitions.
   6. Abbreviations.

B. Related documents and sections:
   1. Document 00700 – General Conditions of the Contract
      a. Basic responsibilities and rights of the Owner.
      b. Basic responsibilities of the Contractor.
   2. Section 01230 Alternatives: Alternates which increase the scope of the Project.

1.2 WORK COVERED BY THE CONTRACT DOCUMENTS

A. Work of this Contract covers the construction of:
   1. Building Addition: 1,950 +/- (heated) SF one story building.
      a. Concrete turn down footings with slab on grade
      b. Light gauge metal wall framing
      c. “C” shape metal roof framing
      d. TPO roofing system
      e. Metal roofing system
      f. Metal wall panels
      g. Aluminum exterior doors and windows
      h. HM doors and frames
      i. Solid core wood doors
      j. Carpet tile
      k. Ceramic tile
      l. Lay-in ceiling systems
      m. Gypsum board
      n. Painting
      o. Restroom plumbing fixtures
      p. Variable Refrigerant Flow HVAC system
      q. Service connection
      r. LED lighting
   2. Remodel of existing building: 2,745 +/- SF one story building.
      a. Select demolition
      b. Faux stone veneer
      c. TPO roofing system
      d. Stucco
e. Metal wall panels  
f. Aluminum exterior doors and windows  
g. HM doors and frames  
h. Solid core wood doors  
i. Carpet tile  
j. Ceramic tile  
k. Lay-in ceiling systems  
l. Gypsum board  
m. Painting  
n. Commercial kitchen equipment  
o. Variable Refrigerant Flow HVAC system  
p. Make Up Air Unit & exhaust fans  
q. LED lighting  

3. Utility connections, flag poles, all weather HC access path, and other related site construction.

1.3 CONTRACTOR’S DUTIES

A. Except as noted, provide and pay for all labor materials, and equipment.

B. Pay required sales, gross receipts and other taxes.

C. Give required notices.

D. Comply with codes, ordinances, regulations and other legal requirements of the authorities having jurisdiction.

1.4 CONTRACTOR USE OF SITE

A. Contractor's Use of Premises: During construction, Contractor shall have full use of site indicated. Contractor's use of premises is limited only by Owner's right to perform work or employ other contractors on portions of Project.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011100
SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes administrative and procedural requirements necessary to prepare and process
      Applications for Payment.
   B. Related Requirements:
      1. Section 012100 "Allowances" for procedural requirements governing the handling and
         processing of allowances.
      2. Section 012200 "Unit Prices" for administrative requirements governing the use of unit
         prices.
      3. Section 012600 "Contract Modification Procedures" for administrative procedures for
         handling changes to the Contract.
      4. Section 013200 "Construction Progress Documentation" for administrative requirements
         governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS
   A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum
      to various portions of the Work and used as the basis for reviewing Contractor's Applications for
      Payment.

1.4 SCHEDULE OF VALUES
   A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's
      construction schedule.
   1. Coordinate line items in the schedule of values with other required administrative forms
      and schedules, including the following:
      a. Application for Payment forms with continuation sheets.
      b. Submittal schedule.
      c. Items required to be indicated as separate activities in Contractor's construction
         schedule.
2. Submit the schedule of values to Architect at earliest possible date, but no later than seven (7) days before the date scheduled for submittal of initial Applications for Payment.

3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.

4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract as described in Section 011000 "Summary."

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:
   a. Project name and location.
   b. Name of Architect.
   c. Architect's project number.
   d. Contractor's name and address.
   e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.

3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
   a. Related Specification Section or Division.
   b. Description of the Work.
   c. Name of subcontractor.
   d. Name of manufacturer or fabricator.
   e. Name of supplier.
   f. Change Orders (numbers) that affect value.
   g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

   1) Labor.
   2) Materials.
   3) Equipment.


5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.

10. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

11. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Submit Application for Payment to Architect by the 1st and 16th of the month. The period covered by each Application for Payment is 15 to 16 days.

1. Submit draft copy of Application for Payment five days prior to due date for review by Architect.

D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

E. Application for Payment Forms: Use forms provided by Owner for Applications for Payment. Sample copies are included in Project Manual.

F. Application for Payment Forms: Use forms acceptable to the Owner for Applications for Payment. Submit forms for approval with initial submittal of schedule of values.
G. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Owner will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

H. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:
   a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
   b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
   c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

I. Transmittal: Submit four (4) signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

J. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
K. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.

L. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Sustainable design submittal for project materials cost data.
4. Contractor's construction schedule (preliminary if not final).
5. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
6. Products list (preliminary if not final).
7. Sustainable design action plans.
8. Schedule of unit prices.
9. Submittal schedule (preliminary if not final).
10. List of Contractor's staff assignments.
11. List of Contractor's principal consultants.
16. Certificates of insurance and insurance policies.
17. Performance and payment bonds.
18. Data needed to acquire Owner's insurance.

M. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

N. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited to, the following:
1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900
SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. Requests for Information (RFIs).
4. Project Web site.
5. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Section 011200 "Multiple Contract Summary" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
2. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
3. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
4. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
5. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within [15] days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.

b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.

c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.

d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.

e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.

f. Indicate required installation sequences.

g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.

2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.

3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.

4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.

5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

6. Mechanical and Plumbing Work: Show the following:
   a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
   b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
   c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:
   a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
   b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
   c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
   d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:
   a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Preparation Format: DWG
3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
   a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
   b. Digital Data Software Program: Drawings are available in dwg format.
   c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.7 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

   1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
   2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

   1. Project name.
   2. Project number.
   3. Date.
   4. Name of Contractor.
   5. Name of Architect
   6. RFI number, numbered sequentially.
   7. RFI subject.
   8. Specification Section number and title and related paragraphs, as appropriate.
   9. Drawing number and detail references, as appropriate.
   10. Field dimensions and conditions, as appropriate.
   11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   12. Contractor's signature.
   13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

   a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: AIA Document G716 OR Software-generated form with substantially the same content as indicated above, acceptable to Architect.

   1. Attachments shall be electronic files in Adobe Acrobat PDF format.

D. Architect's Action: Architect[ and Construction Manager] will review each RFI, determine action required, and respond. Allow seven (7) working days for Architect's response for each RFI.
RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:
   a. Requests for approval of submittals.
   b. Requests for approval of substitutions.
   c. Requests for approval of Contractor's means and methods.
   d. Requests for coordination information already indicated in the Contract Documents.
   e. Requests for adjustments in the Contract Time or the Contract Sum.
   f. Requests for interpretation of Architect's actions on submittals.
   g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.

3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within [10] days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven (7) days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.8 PROJECT MEETINGS

A. General: [Schedule and conduct] [Construction Manager will schedule and conduct] meetings and conferences at Project site unless otherwise indicated.
1. **Attendees:** Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.

2. **Agenda:** Prepare the meeting agenda. Distribute the agenda to all invited attendees.

3. **Minutes:** Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager, and Architect, within [three] days of the meeting.

B. **Preconstruction Conference:** The Owner will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than fifteen days after execution of the Agreement.

1. **Conduct the conference to review responsibilities and personnel assignments.**

2. **Attendees:** Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

3. **Agenda:** Discuss items of significance that could affect progress, including the following:
   
   a. Tentative construction schedule.
   
   b. Phasing.
   
   c. Critical work sequencing and long-lead items.
   
   d. Designation of key personnel and their duties.
   
   e. Lines of communications.
   
   f. Procedures for processing field decisions and Change Orders.
   
   g. Procedures for RFI.
   
   h. Procedures for testing and inspecting.
   
   i. Procedures for processing Applications for Payment.
   
   j. Distribution of the Contract Documents.
   
   k. Submittal procedures.
   
   l. Sustainable design requirements.
   
   m. Preparation of record documents.
   
   n. Use of the premises.
   
   o. Work restrictions.
   
   p. Working hours.
   
   q. Owner's occupancy requirements.
   
   r. Responsibility for temporary facilities and controls.
   
   s. Procedures for moisture and mold control.
   
   t. Procedures for disruptions and shutdowns.
   
   u. Construction waste management and recycling.
   
   v. Parking availability.
   
   w. Office, work, and storage areas.
   
   x. Equipment deliveries and priorities.
   
   y. First aid.
   
   z. Security.
   
   aa. Progress cleaning.

4. **Minutes:** Entity responsible for conducting meeting will record and distribute meeting minutes.
C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, and Owner's Commissioning Authority of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

   b. Options.
   c. Related RFIs.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Sustainable design requirements.
   i. Review of mockups.
   j. Possible conflicts.
   k. Compatibility requirements.
   l. Time schedules.
   m. Weather limitations.
   n. Manufacturer's written instructions.
   o. Warranty requirements.
   q. Acceptability of substrates.
   r. Temporary facilities and controls.
   s. Space and access limitations.
   t. Regulations of authorities having jurisdiction.
   u. Testing and inspecting requirements.
   v. Installation procedures.
   w. Coordination with other work.
   x. Required performance results.
   y. Protection of adjacent work.
   z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: The Owner will conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than thirty 30 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, **Owner's Commissioning Authority**, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
   a. Preparation of record documents.
   b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
   c. Submittal of written warranties.
   d. Requirements for completing sustainable design documentation.
   e. Requirements for preparing operations and maintenance data.
   f. Requirements for delivery of material samples, attic stock, and spare parts.
   g. Requirements for demonstration and training.
   h. Preparation of Contractor's punch list.
   i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
   j. Submittal procedures.
   k. Coordination of separate contracts.
   l. Owner's partial occupancy requirements.
   m. Installation of Owner's furniture, fixtures, and equipment.
   n. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: **Conduct** progress meetings at bi-weekly intervals.

   1. Coordinate dates of meetings with preparation of payment requests.
   2. Attendees: In addition to representatives of Owner, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
   3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
      a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
         1) Review schedule for next period.
      b. Review present and future needs of each entity present, including the following:
         1) Interface requirements.
         2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Status of sustainable design documentation.
6) Deliveries.
7) Off-site fabrication.
8) Access.
9) Site utilization.
10) Temporary facilities and controls.
11) Progress cleaning.
12) Quality and work standards.
13) Status of correction of deficient items.
14) Field observations.
15) Status of RFIs.
16) Status of proposal requests.
17) Pending changes.
18) Status of Change Orders.
19) Pending claims and disputes.
20) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

   a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

   1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

   2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

      a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

      b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

      c. Review present and future needs of each contractor present, including the following:
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100
SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's construction schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Special reports.

B. Related Requirements:

1. Section 011200 "Multiple Contract Summary" for preparing a combined Contractor's construction schedule.
2. Section 013300 "Submittal Procedures" for submitting schedules and reports.
3. Section 014000 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.
C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.
   1. Float time belongs to Owner.
   2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
   3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:
   1. Working electronic copy of schedule file, where indicated.
   2. PDF electronic file.
   3. Two <2> paper copies.

B. Startup construction schedule.
   1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
   1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
   1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Site Condition Reports: Submit at time of discovery of differing conditions.

I. Special Reports: Submit at time of unusual event.

J. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including work stages and interim milestones.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.
PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 15 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule:
   a. Coordination with existing construction.
   b. Limitations of continued occupancies.
   c. Uninterruptible services.
   d. Partial occupancy before Substantial Completion.
   e. Use of premises restrictions.
7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
   a. Subcontract awards.
   b. Submittals.
   c. Purchases.
   d. Mockups.
   e. Fabrication.
   f. Sample testing.
   g. Deliveries.
   h. Installation.
   i. Tests and inspections.
   j. Adjusting.
   k. Curing.
   l. Building flush-out.
   m. Startup and placement into final use and operation.

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
   a. Structural completion.
   b. Temporary enclosure and space conditioning.
   c. Permanent space enclosure.
   d. Completion of mechanical installation.
   e. Completion of electrical installation.
   f. Substantial Completion.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1. Use Microsoft Project

2.2 SCHEDULE

A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within [30] <Insert number> days of date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award]. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in [10] <Insert number> percent increments within time bar.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within [14] <Insert number> days of date established for Notice of Award. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's construction schedule using a cost-loaded, time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for notice of award.
   
a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.

3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

   a. Preparation and processing of submittals.
   b. Mobilization and demobilization.
   c. Purchase of materials.
   d. Delivery.
   e. Fabrication.
   f. Utility interruptions.
   g. Installation.
   h. Work by Owner that may affect or be affected by Contractor's activities.
   i. Testing and commissioning.
   j. Punch list and final completion.
   k. Activities occurring following final completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.

3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.

4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

   a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, [sustainable design documentation,] and
demonstration and training (if applicable), in the amount of [5] *Insert number* percent of the Contract Sum.

a. Each activity cost shall reflect an appropriate value subject to approval by Architect.

b. Total cost assigned to activities shall equal the total Contract Sum.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
5. Changes in the critical path.
6. Changes in total float or slack time.

H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.

   a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.

   b. Submit value summary printouts [one week] *Insert time* before each regularly scheduled progress meeting.
2.5 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.6 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.

2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

B. Contractor's Construction Schedule Updating: At bi-monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week Insert time before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.

2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.

3. As the Work progresses, indicate final completion percentage for each activity.

C. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200
SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
4. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
5. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
   a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
   a. Scheduled date for first submittal.
   b. Specification Section number and title.
   c. Submittal category: Action; informational.
   d. Name of subcontractor.
   e. Description of the Work covered.
   f. Scheduled date for Architect's final release or approval.
   g. Scheduled date of fabrication.
   h. Scheduled dates for purchasing.
   i. Scheduled dates for installation.
   j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

   a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

   a. **Architect reserves** right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. **Processing Time:** Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on [Architect’s] [Construction Manager’s] receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

   1. **Initial Review:** Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.

   2. **Intermediate Review:** If intermediate submittal is necessary, process it in same manner as initial submittal.

   3. **Resubmittal Review:** Allow 15 days for review of each resubmittal.

   4. **Sequential Review:** Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

      a. *<Insert list of Specification Sections requiring sequential review>.*

   5. **Concurrent Consultant Review:** Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect [Construction Manager, through Architect,] before being returned to Contractor.

D. **Paper Submittals:** Place a permanent label or title block on each submittal item for identification.

   1. Indicate name of firm or entity that prepared each submittal on label or title block.

   2. Include the following information for processing and recording action taken:

      a. Project name.

      b. Date.

      c. Name of Architect.

      d. Name of Construction Manager.

      e. Name of Contractor.

      f. Name of subcontractor.

      g. Name of supplier.

      h. Name of manufacturer.

      i. Submittal number or other unique identifier, including revision identifier.

   1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
j. Number and title of appropriate Specification Section.
k. Drawing number and detail references, as appropriate.
l. Location(s) where product is to be installed, as appropriate.
m. Other necessary identification.

3. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.

4. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will [return without review] [discard] submittals received from sources other than Contractor.

a. Transmittal Form for Paper Submittals: Use AIA Document G810
b. Transmittal Form for Paper Submittals: Provide locations on form for the following information:

   1) Project name.
   2) Date.
   3) Destination (To:).
   4) Source (From:).
   5) Name and address of Architect.
   6) Name of Construction Manager.
   7) Name of Contractor.
   8) Name of firm or entity that prepared submittal.
   9) Names of subcontractor, manufacturer, and supplier.
  10) Category and type of submittal.
  11) Submittal purpose and description.
  12) Specification Section number and title.
  13) Specification paragraph number or drawing designation and generic name for each of multiple items.
  14) Drawing number and detail references, as appropriate.
  15) Indication of full or partial submittal.
  16) Transmittal number[ numbered consecutively].
  17) Submittal and transmittal distribution record.
  18) Remarks.
  19) Signature of transmitter.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.

4. Transmittal Form for Electronic Submittals: Use form acceptable to Owner, containing the following information:

   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Name of firm or entity that prepared submittal.
   g. Names of subcontractor, manufacturer, and supplier.
   h. Category and type of submittal.
   i. Submittal purpose and description.
   j. Specification Section number and title.
   k. Specification paragraph number or drawing designation and generic name for each of multiple items.
   l. Drawing number and detail references, as appropriate.
   m. Location(s) where product is to be installed, as appropriate.
   n. Related physical samples submitted directly.
   o. Indication of full or partial submittal.
   p. Transmittal number[, numbered consecutively].
   q. Submittal and transmittal distribution record.
   r. Other necessary identification.
   s. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:

   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

F. Options: Identify options requiring selection by Architect.

G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

   1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect’s action stamp.

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect’s action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files.

3. Informational Submittals: Submit [two] paper copies of each submittal unless otherwise indicated. Architect will not return copies.
4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
   a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
   b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's catalog cuts.
   b. Manufacturer's product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.

f. Application of testing agency labels and seals.

g. Notation of coordination requirements.

h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams showing factory-installed wiring.

b. Printed performance curves.

c. Operational range diagrams.

d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.

6. Submit Product Data in the following format:

a. PDF electronic file.


C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect’s digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.

b. Schedules.

c. Compliance with specified standards.

d. Notation of coordination requirements.

e. Notation of dimensions established by field measurement.

f. Relationship and attachment to adjoining construction clearly indicated.

g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least [8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm)] <Insert dimensions>.

3. Submit Shop Drawings in the following format:

a. PDF electronic file.

b. [Two] opaque (bond) copies of each submittal. Architect will return [one] copy(ies).

c. [Three] opaque copies of each submittal. Architect will retain [two] copies; remainder will be returned.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Attach label on unexposed side of Samples that includes the following:
   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of applicable Specification Section.
   e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit [one] full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Number of Samples: Submit [three] sets of Samples. Architect will retain [two] Sample sets; remainder will be returned. [Mark up and retain one returned Sample set as a project record sample.]
      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least [three] sets of paired units that show approximate limits of variations.
E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:
   a. PDF electronic file.
   b. [Three] paper copies of product schedule or list unless otherwise indicated. Architect will return [two] copies.

F. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."

G. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
   1. Name of evaluation organization.
   2. Date of evaluation.
   3. Time period when report is in effect.
   4. Product and manufacturers’ names.
   5. Description of product.
   6. Test procedures and results.
   7. Limitations of use.

U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit [digitally signed PDF electronic file] [and] [three] paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. BIM File Incorporation: [Incorporate] [Construction Manager will incorporate] delegated-design drawing and data files into Building Information Model established for Project.

1. Prepare delegated-design drawings in the following format: [Same digital data software program, version, and operating system as the original Drawings] [<Insert software name and version>].

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate [action.] [action, as follows:]

1. <Insert description of each action indicated on Architect's (and Construction Manager's) stamp>.
B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300
SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner and authorities having jurisdiction are not limited by provisions of this Section.

4. Specific test and inspection requirements are not specified in this Section.

C. Related Requirements:

1. Section 012100 "Allowances" for testing and inspecting allowances.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to
show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.
2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of [five] previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A.Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within [10] days of Notice to Proceed, and not less than [five] days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
B. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

C. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.

D. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

E. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to [ASTM E 329]; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:
   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
   d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
   e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
   f. When testing is complete, remove test specimens, assemblies; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.9 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
   a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least [24] hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.


1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.
1.10 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Engage a qualified testing agency and special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in Statement of Special Inspections attached to this Section], and as follows:

B. Special Tests and Inspections: Conducted by a qualified testing agency and or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as
possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000
SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 012100 "Allowances" for products selected under an allowance.
2. Section 012300 "Alternates" for products selected under an alternate.
3. Section 012500 "Substitution Procedures" for requests for substitutions.
4. Section 014200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.
1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
   a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
   b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.


1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

4. Where products are accompanied by the term "as selected," Architect will make selection.


6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

3. Products:
   a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
   b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:
   a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
   b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

3. Evidence that proposed product provides specified warranty.

4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.

5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000
SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 QUALITY ASSURANCE
A. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of [two] permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.

3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of [96 inches (2440 mm)] in occupied spaces and [90 inches (2300 mm)] in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. **Concrete and Masonry**: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

6. Proceed with patching after construction operations requiring cutting are complete.
H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.
3.8 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
   a. Use containers intended for holding waste materials of type to be stored.
4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal".

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300
SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Section 013233 "Photographic Documentation" for submitting final completion construction photographic documentation.
2. Section 017300 "Execution" for progress cleaning of Project site.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
4. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
5. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.
CLOSEOUT PROCEDURES

C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of [10] days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.

3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by [Architect]. Label with manufacturer's name and model number where applicable.

   a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain [Architect's] signature for receipt of submittals.

5. Submit test/adjust/balance records.

6. Submit sustainable design submittals not previously submitted.

7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of [10] days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.

2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of [10] days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. [Use CSI Form 14.1A.]

1. Organize list of spaces in sequential order, starting with exterior areas first.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of Contractor.
   e. Page number.

4. Submit list of incomplete items in the following format:

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within [15] days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.
PART 2 - PRODUCTS

2.1 MATERIALS

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

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from Project site.
   e. Remove snow and ice to provide safe access to building.
   f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   h. Sweep concrete floors broom clean in unoccupied spaces.
   i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
   j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
   k. Remove labels that are not permanent.
CLOSEOUT PROCEDURES

END OF SECTION 017700
SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

B. Related Requirements:

1. Section 011200 "Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
2. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
3. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect and Commissioning Authority will comment on whether content of operations and maintenance submittals are acceptable.

2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
B. Format: Submit operations and maintenance manuals in the following format:

   a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
   b. Enable inserted reviewer comments on draft submittals.

2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return one copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the
2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so
that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, **loose-leaf** binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
   a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
   b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.


5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
5. Power failure.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual’s table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer’s name.
3. Color, pattern, and texture.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer’s written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.
2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.
PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."

G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823
SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents,
   including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 011200 "Multiple Contract Summary" for coordinating project record documents
   covering the Work of multiple contracts.
2. Section 017300 "Execution" for final property survey.
3. Section 017700 "Closeout Procedures" for general closeout procedures.
4. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual
   requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit [one] set(s) of marked-up record prints.
2. Number of Copies: Submit copies of record Drawings as follows:
   a. Initial Submittal:
      1) Submit [one] paper-copy set(s) of marked-up record prints.
      2) Submit PDF electronic files of scanned record prints and [one] of file prints.
      3) Submit record digital data files and [one] set(s) of plots.
      4) Architect will indicate whether general scope of changes, additional
         information recorded, and quality of drafting are acceptable.
   b. Final Submittal:
      1) Submit [three] paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and [three] set(s) of prints.
3) Print each drawing, whether or not changes and additional information were recorded.

c. Final Submittal:
   1) Submit [one] paper-copy set(s) of marked-up record prints.
   2) Submit record digital data files and [three] set(s) of record digital data file plots.
   3) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy of each submittal.

   1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy of each submittal.

E. Reports: Submit written report [weekly] indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

   1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Accurately record information in an acceptable drawing technique.
      c. Record data as soon as possible after obtaining it.
      d. Record and check the markup before enclosing concealed installations.
      e. Cross-reference record prints to corresponding archive photographic documentation.
2. Content: Types of items requiring marking include, but are not limited to, the following:

   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made by Change Order or Change Directive.
   k. Changes made following Architect's written orders.
   l. Details not on the original Contract Drawings.
   m. Field records for variable and concealed conditions.
   n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.

4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
2. Refer instances of uncertainty to Architect for resolution.
   a. See Section 013300 "Submittal Procedures" for requirements related to use of Architect's digital data files.
   b. Architect will provide data file layer information. Record markups in separate layers.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.

1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Architect
   e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as **paper copy**.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders and record Drawings where applicable.

B. Format: Submit record Product Data as **paper copy**.
1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as **paper copy**

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839
SECTION 032000 – CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents:
   1. Drawings and general provisions of the Subcontract apply to this Section.
   2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes: Concrete reinforcement and accessories.

C. Related Sections:
   1. Division 01 Section "General Requirements."
   2. Division 01 Section "Special Procedures."

1.2 REFERENCES

A. General:
   1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
   2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
   3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

B. ACI – American Concrete Institute:
   1. ACI 117 Tolerances for Concrete Construction
   2. ACI 301 Specifications for Structural Concrete
   3. ACI 315 Standard Practice for Detailing Reinforced Concrete Structures

C. ASTM International:
   1. ASTM A185 / A185M Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
   2. ASTM A615 / A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
   3. ASTM A706 / A706M Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
   4. ASTM A970 / A970M Standard Specification for Headed Steel Bars for Concrete Reinforcement


E. ICBO - Evaluation Reports.
1.3 SUBMITTALS

A. Submit under provisions of Division 01 Section "General Requirements."

B. Shop Drawings: Prepare placing drawings in accordance with ACI 315. Show size, shape and location of bars and wire fabric in structure. Show splice locations and lengths. Where details are not shown, conform to standards of practice indicated in ACI 315 and submit for approval.
   1. Bill reinforcing bars for walls on elevations. Bill reinforcing bars for slabs on plans. Plans and elevations need not be true views. When more than one wall or slab are identical, only one such wall or slab is required. Take sections to clarify the arrangement of reinforcement. Identify, but do not bill bars on sections.
   2. Unless the location of reinforcing is clear, give dimensions to some structural feature that will be readily distinguishable at time bars are placed.
   3. Make placing drawings complete, including the location of support bars and chairs, without reference to the design drawings.

C. Submit data required to evaluate proposed mechanical splices.

D. Submit manufacturer's certified mill test reports on each heat of reinforcing steel delivered, showing physical and chemical analysis before placing reinforcement.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of ACI 301 CRSI's "Manual of Standard Practice", except where more stringent requirements are shown or specified.

B. Requirements of Regulatory Agencies: Proprietary products, including bar couplers, shall have an active ICBO Evaluation Report.

C. Material Quality Assurance: Mill test reports including chemical analysis, tensile properties and bend test shall be examined for all reinforcing. Conform to one of the following:

D. Maintain positive identification of reinforcing by heat number. Provide certified mill test reports to Testing Laboratory.

E. Where positive identification cannot be made and procedures are not deemed adequate to ensure compliance, Testing Laboratory will randomly sample and make one tensile and one bend test from each 2-1/2 tons or fraction thereof of each size of reinforcement. Subcontractor will bear the cost of testing.

PART 2 - PRODUCTS

2.1 REINFORCING MATERIALS

A. Bar Reinforcement: ASTM A615, Grade 60, deformed billet bars.
1. ASTM A706, where noted on Drawings.
2. Recycled content shall be a minimum of 75 percent recycled post consumer steel.


C. Spirals: ASTM A82.


E. Threaded Bars: Grade 75, manufactured by DYWIDAY Systems International, Williams Form Engineering Corp. or equal substituted per Division 1.

F. Smooth Dowels, ASTM A615, Grade 40 or 60, smooth; sawcut or grind one end to remove offsets; shop paint with iron oxide zinc chromate primer.

G. Welded Deformed Bar Anchors: ASTM A-108 $f_y = 70,000$ psi, flux-filled deformed bar anchors welded to structural steel as shown; Nelson D2L, or equal substituted per Division 1.

H. Mechanical Bar Couplers: Provide mechanical couplers with a current ICC evaluation report. Coupler shall develop 160% percent of specified minimum yield strength of spliced reinforcement. Subject to compliance with requirements provide one of the following, or approved equal:
   1. Barteck, Dextra Inc.
   2. Lenton Taper Threaded Connection, Erico Inc.
   3. Bar Lock, Dayton Superior Inc.

2.2 ACCESSORIES

A. Tie Wire: Minimum 16-gage black annealed wire.

B. Bar Supports:
   1. At surfaces not exposed to view in completed structure: Precast concrete bar supports with two 16 ga. embedded wires or CRSI Class 2 wire supports.
   2. Supports placed against ground or on top of vapor barrier: Precast concrete blocks not less than 3 inches square (1935 mm²) with two 16 ga. embedded wires.
   3. At Architectural Concrete and surfaces exposed to weather: CRSI Class 2 stainless steel or CRSI Class 1 plastic protected.
   4. Where support is no closer to concrete surface than 1/2 inch (13 mm): CRSI Class 3 wire supports.

2.3 FABRICATION

A. Fabricate reinforcement in accordance with ACI 315 where specific details are not shown.

PART 3 - EXECUTION
3.1 PLACEMENT

A. Surface Condition of Reinforcement: Before placing concrete, clean reinforcement of loose scale, dirt, grease and other substances which would impair bond with concrete.

B. Place reinforcement in accordance with the Drawings and the CRSI Manual.
   1. Steel bars shall be of size and length indicated, accurately bent or formed to shapes detailed or scheduled by experienced shops by methods that will not injure the materials. Reinforcing bars shall be shop fabricated to lengths and bends shown on the drawings. Fabrication tolerance shall be in accordance with the requirements of ACI 315.
   2. Reinforcing bars shall be as long as possible with a minimum number of joints.
   3. Steel reinforcement shall not be bent or straightened in a manner that will injure the material or the embedding concrete. Bars with kinks or bends not shown on the Drawings shall not be used. Heating of reinforcement for bending will not be permitted.
   4. Reinforcement shall be tagged with suitable identification to facilitate sorting and placing.

C. Place reinforcing bars accurately as to spacing and clearance and securely tied at intersections and supports with wire and in such a manner as will preclude displacement during pouring of concrete. Placing tolerances shall be in conformance with the requirements of ACI 117.

D. Place and secure reinforcement to maintain the proper distance and clearance between parallel bars and from the forms. Provide vertical steel with metal spreaders to maintain steel properly centered in the forms. Horizontal reinforcement shall be supported at proper height on concrete pads, chairs or transverse steel bars.

E. After placing, maintain bars in a clean condition until completely embedded in concrete.

F. Bars shall not be spaced closer than 1-1/2 diameters of the largest of two adjacent bars, 1-1/2 times the maximum aggregate size, nor one inch, except at bar laps. Where reinforcement in members is placed in two layers, the clear distance between layers shall be not less than one inch (25 mm) or more than 1-1/2 inches (13 mm) unless otherwise noted on the drawings. The bars in the upper layer shall be placed directly above those in the bottom layer unless otherwise detailed.

G. Coverage of bars shall be as shown and scheduled. Conform to ACI 301 where not indicated.

H. Where obstruction prevents the intended placement of reinforcement, provide additional reinforcement as directed by the University around the obstruction.

I. Splice bars as indicated by lapping and securely wiring together. Splices at locations other than those indicated are subject to the approval of the University. Splices of reinforcement shall not be made at the point of maximum stress. Splices shall provide sufficient lap to transfer the stress between bars by bond and shear. Bars shall be spread the minimum distance specified. Stagger splices of adjacent bars where possible.
J. Reinforcing bars shall not have welded joints.

K. Mechanical Bar Couplers: Install in accordance with applicable ICC evaluation report. Maintain clearance and coverage at coupler. Stagger couplers wherever practical.

3.2 FIELD INSPECTION

A. University Testing Laboratory will:
   2. Special Inspect placement of reinforcement for conformance with the Contract Documents and as required by CBC Chapter 17.
   3. Special Inspect installation of mechanical couplers in accordance with requirements of applicable ICC evaluation report.
   4. Special Inspect shop and field welding as required by CBC Chapter 17

END OF SECTION 032000
SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
2. Section 035300 "Concrete Topping" for emery- and iron-aggregate concrete floor toppings.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
4. Section 321313 "Concrete Paving" for concrete pavement and walks.
5. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
   d. Concrete Subcontractor.
e. Special concrete finish Subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness and concrete protection.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

E. Samples: For waterstops and vapor retarder.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer testing agency.

B. Welding certificates.

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

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.

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

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

E. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
1. Build panel approximately 200 sq. ft. (18.6 sq. m) for slab-on-grade in the location indicated or, if not indicated, as directed by Architect.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.10 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

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

CAST-IN-PLACE CONCRETE
1. ACI 301 (ACI 301M).
2. ACI 117 (ACI 117M).

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.
   2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      a. High-density overlay, Class 1 or better.
      b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
      c. Structural 1, B-B or better; mill oiled and edge sealed.
      d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

I. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that leave no corrordable metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
C. Galvanized Reinforcing Bars: as indicated on Structural Drawings.
D. Epoxy-Coated Reinforcing Bars: as indicated on Structural Drawings.
E. Stainless-Steel Reinforcing Bars: as indicated on Structural Drawings.
F. Steel Bar Mats: ASTM A 184/A 184M, fabricated as indicated on Structural Drawings.
G. Plain-Steel Wire: ASTM A 1064/A 1064M, as indicated on Structural Drawings.
H. Deformed-Steel Wire: ASTM A 1064/A 1064M.
I. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A, Type 1 coated, steel wire, with less than 2 percent damaged coating in each 12-inch (300-mm) wire length and as indicated on Structural Drawings.
J. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.
L. Galvanized-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from galvanized-steel wire into flat sheets.
M. Epoxy-Coated Welded-Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, steel.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, ASTM A 775/A 775M epoxy coated.
C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.
D. Zinc Repair Material: ASTM A 780/A 780M.
E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

2. Fly Ash: ASTM C 618, as indicated on Structural Drawings.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, Grade as indicated on Structural Drawings. with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: nominal as indicated on Structural Drawings.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C 330/C 330M, nominal maximum aggregate size as indicated on Structural Drawings.

E. Air-Entraining Admixture: ASTM C 260/C 260M.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
G. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

H. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

I. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
   1. Color: As selected by Architect from manufacturer’s full range.

J. Water: ASTM C 94/C 94M

2.6 FIBER REINFORCEMENT

A. Carbon-Steel Fiber: ASTM A 820/A 820M, Type 1, cold-drawn wire, deformed as indicated on Structural Drawings.

B. Carbon-Steel Fiber: ASTM A 820/A 820M, Type 2, cut sheet, deformed as indicated on Structural Drawings.

C. Synthetic Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III as indicated on Structural Drawings.

D. Synthetic Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, as indicated on Structural Drawings.

E. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, as indicated on Structural Drawings.

2.7 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513 for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.

C. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch (10 by 19 mm).

2.8 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

B. Sheet Vapor Retarder: ASTM E 1745, Class B. Include manufacturer's recommended adhesive or pressure-sensitive tape.

C. Sheet Vapor Retarder: ASTM E 1745, Class C. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

D. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick.

E. Bituminous Vapor Retarder: 110-mil- (2.8-mm-) thick, semiflexible, seven-ply sheet membrane consisting of reinforced core and carrier sheet with fortified asphalt layers, protective weathercoating, and removable plastic release liner. Furnish manufacturer's accessories, including bonding asphalt, pointing mastics, and self-adhering joint tape.

2.9 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing as indicated on Structural Drawings.

B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

C. Emery Dry-Shake Floor Hardener: factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.

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

D. Metallic Dry-Shake Floor Hardener: factory-packaged, dry combination of portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture; with metallic aggregate consisting of no less than 65 percent of total aggregate content.

1. Color: As selected by Architect from manufacturer's full range.
E. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

F. Pigmented Mineral Dry-Shake Floor Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

2.10 LIQUID FLOOR TREATMENTS

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

2.11 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.12 RELATED MATERIALS

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 according to ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

E. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: as indicated on Structural Drawings.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: as indicated on Structural Drawings.

2.14 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

1. Fly Ash: 25 percent.
4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened as indicated on Structural Drawings.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal-weight concrete.

1. Minimum Compressive Strength: as indicated on Structural Drawings.
2. Maximum W/C Ratio: as indicated on Structural Drawings.
3. Slump Limit: as indicated on Structural Drawings.
4. Air Content: as indicated on Structural Drawings.

B. Slabs-on-Grade: Normal-weight concrete.

1. Minimum Compressive Strength: as indicated on Structural Drawings.
2. Maximum W/C Ratio: as indicated on Structural Drawings.
3. Slump Limit: as indicated on Structural Drawings.
4. Air Content: as indicated on Structural Drawings.
C. Concrete Toppings: Normal-weight concrete.
   1. Minimum Compressive Strength: as indicated on Structural Drawings.
   2. Maximum W/C Ratio: as indicated on Structural Drawings.
   3. Slump Limit: as indicated on Structural Drawings.
   4. Air Content: as indicated on Structural Drawings.

2.16 FABRICATING REINFORCEMENT
   A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.17 CONCRETE MIXING
   A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94 and ASTM C 1116/C 1116M, and furnish batch ticket information.
      1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
   B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
      1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
      2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
      3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION
   A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
   B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M).
   C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as indicated on the Structural Drawings.
   D. Construct forms tight enough to prevent loss of concrete mortar.
E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.

2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 (ACI 318M) and ACI 301 (ACI 301M) for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.6 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
CAST-IN-PLACE CONCRETE

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780/A 780M. Use galvanized-steel wire ties to fasten zinc-coated steel reinforcement.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch (3.2-mm) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOP INSTALLATION

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

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

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).

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

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

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

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.


3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

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

3.11 FINISHING FLOORS AND SLABS

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

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.

1. Apply scratch finish to surfaces where indicated on the Drawings.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces where indicated on the Drawings.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces where indicated on the Drawings.

2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:

   a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

   b. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.

   c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.

   d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.
3. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch (6 mm).

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where indicated on the Drawings. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread dampened slip-resistive material over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive material.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. (49 kg/10 sq. m) unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.12 MISCELLANEOUS CONCRETE ITEM INSTALLATION

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

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches (100 mm) high unless otherwise indicated, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 (ACI 301M) for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer’s written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENT APPLICATION

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

   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

   2. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

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

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's
written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

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

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

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

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.

6. Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Compression Test Specimens: ASTM C 31/C 31M.

   a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

   b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.

   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

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

15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000
SECTION 033053 - MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
2. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture.

1.4 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. Comply with the following sections of ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents:

1. "General Requirements."
2. "Formwork and Formwork Accessories."
3. "Reinforcement and Reinforcement Supports."
4. "Concrete Mixtures."
5. "Handling, Placing, and Constructing."
6. "Lightweight Concrete."
B. Comply with ACI 117 (ACI 117M).

2.2 STEEL REINFORCEMENT
A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
B. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.
C. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 CONCRETE MATERIALS
A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
B. Cementitious Materials:
   1. Portland Cement: ASTM C 150/C 150M, Type as indicated on Structural Drawings.
   2. Fly Ash: ASTM C 618, Class C or F.
   3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
C. Normal-Weight Aggregate: ASTM C 33/C 33M, 1-1/2-inch (38-mm) nominal maximum aggregate size.
E. Air-Entraining Admixture: ASTM C 260/C 260M.
F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
G. Water: ASTM C 94/C 94M.
2.4  FIBER REINFORCEMENT

   A.  Synthetic Micro-Fiber: Monofilament or fibrillated polypropylene micro-fbers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.

2.5  RELATED MATERIALS

   A.  Vapor Retarder: Plastic sheet, ASTM E 1745, Class A or B.

   B.  Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick; or plastic sheet, ASTM E 1745, Class C.

   C.  Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

2.6  CURING MATERIALS

   A.  Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

   B.  Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.

   C.  Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

   D.  Water: Potable.

   E.  Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

   F.  Clear, Waterborne Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.7  CONCRETE MIXTURES

   A.  Comply with ACI 301 (ACI 301M).

   B.  Normal-Weight Concrete:

         1.  Minimum Compressive Strength: as indicated on Structural Drawings at 28 days.

         2.  Maximum W/C Ratio: as indicated on Structural Drawings

         3.  Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

         4.  Slump Limit: as indicated on Structural Drawings

         5.  Air Content: Maintain within range permitted by ACI 301 (ACI 301M). Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

   C.  Structural Lightweight Concrete Mix: ASTM C 330/C 330M, proportioned to produce concrete with a minimum compressive strength of 3000 psi (20.7 MPa) at 28 days and a calculated
equilibrium unit weight of 110 lb/cu. ft. (1762 kg/cu. m) plus or minus 3 lb/cu. ft. (48.1 kg/cu. m), as determined by ASTM C 567/C 567M. Concrete slump at point of placement shall be the minimum necessary for efficient mixing, placing, and finishing.

1. Limit slump to 5 inches (125 mm) for troweled slabs and 4 inches (100 mm) for other slabs.

D. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than a rate of 1.0 lb/cu. yd. (0.60 kg/cu. m).

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116, and furnish batch ticket information.

1. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, construct, erect, brace, and maintain formwork according to ACI 301 (ACI 301M).

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR-RETARDER INSTALLATION

A. Install, protect, and repair vapor retarders according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.
1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended adhesive or joint tape.

3.4 STEEL REINFORCEMENT INSTALLATION

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

3.6 CONCRETE PLACEMENT

A. Comply with ACI 301 (ACI 301M) for placing concrete.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).

C. Do not add water to concrete during delivery, at Project site, or during placement.

D. Consolidate concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).

E. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches (100 mm) high unless otherwise indicated; and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: as indicated on Structural Drawings at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor them into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding 1/2 inch (13 mm).

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm).

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following rubbed finish, defined in ACI 301 (ACI 301M), to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-rubbed finish.
2. Grout-cleaned finish.
3. Cork-floated finish.

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

3.8 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.

1. Do not further disturb surfaces before starting finishing operations.

C. Scratch Finish: Apply scratch finish to surfaces indicated and surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes unless otherwise indicated.

D. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, fluid-applied or direct-to-deck-applied membrane roofing, or sand-bed terrazzo.

E. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.

F. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset methods. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.

G. Slip-Resistive Broom Finish: Apply a slip-resistive finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.9 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 (ACI 301M) for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recruit areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recruit areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests: Perform according to ACI 301 (ACI 301M).

   1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

   2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

END OF SECTION 033053
PART 1 GENERAL

1.1 SECTION INCLUDES
   A. Manufactured Stone Veneer.
   B. Manufactured Stone Trim.

1.2 RELATED SECTIONS
   A. Section 04 20 00 - Unit Masonry.
   B. Section 06 10 00 - Rough Carpentry.
   C. Section 07 62 00 - Sheet Metal Flashing and Trim.
   D. Section 07 90 00 - Joint Protection.
   E. Section 09 26 00 - Veneer Plastering.
   F. Section 10 30 00 - Fireplaces and Stoves.

1.3 REFERENCES
   A. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   I. ASTM C 192 - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Performance Requirements:
1. Compressive Strength: Not less than 1800 psi (12.4 MPa) average for 5 specimens and not less than 1500 psi (10.3 MPa) for individual specimen when tested in accordance with ASTM C 39 and ASTM C 192.
2. Bond Between Manufactured Masonry Unit, Mortar and Backing: Not less than 50 psi (345 kPa) when tested in accordance with ASTM C 482 using Type S mortar.
3. Thermal Resistance: R-value of not less than 0.355 per inch (25.4 mm) of thickness when tested in accordance with ASTM C 177.
4. Freeze/Thaw: No disintegration and less than 3 percent weight loss when tested in accordance with ASTM C 67.
5. Unit Weight: Not more than 15 psf (73 kg/m2).
6. Surface Burning Characteristics: Not more than the following when tested in accordance with UL 723:
   a. Flamespread: 25.
   b. Smoke Development: 450.

B. Building Code Compliance:
2. Florida Building Code (FBC): FL4842
3. International Code Council (ICC):
   a. ES Report: ICC ESR 1364
   b. UBC Standard No. 14-1, Kraft Waterproof Building Paper.
4. Texas Department of Insurance: Product Evaluation - EC 21

C. Minimum Recycled Content of 50 percent validated by 3rd party analysis.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Submit drawings depicting proper installation and flashing techniques. Coordinate locations with those found on the Drawings.

D. LEED Submittals: Provide documentation of how the requirements of Credit will be met:
1. **Product Data for Credit MR 4.1 and MR 4.2**: For products having recycled content, documentation including percentages by weight of post-consumer and pre-consumer recycled content.
   a. Include statement indicating costs for each product having recycled content.

2. **Product Data for Credit IAQ 4.6 (Schools)**: For products used in school construction, including certification meeting CHPS Low-Emitting Material criteria Section 01 35 00 - Special Procedures.

3. **Product Data for Credit MR 5.1 and Credit MR 5.2**: Submit data, including location and distance from Project of material manufacturer and point of extraction, harvest or recovery for main raw material.
   a. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

E. **Selection Samples**: For each finish product specified, two complete sets of color sample representing manufacturer's full range of available colors and textures.

F. **Verification Samples**: For each finish product specified, two samples, minimum size 8 inches (203 mm) square, representing actual product, color, and texture.

G. **Manufacturer’s Certificates**: Certify products meet or exceed specified requirements.

H. **Closeout Submittals**: Provide manufacturer’s maintenance instructions that include recommendations for cleaning and repair of components.

1.6 **QUALITY ASSURANCE**

A. **Manufacturer Qualifications**: Manufacturer affiliated with MSJC and ACI with a minimum of 5 years documented experience manufacturing and marketing all Manufactured Stone products in this section.

B. **Installer Qualifications**: Company with documented experience in installation of manufactured masonry of the type specified including at least five projects within a 400 mile (650km) radius of the Project.

C. **Mock-Up**: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish panel of size and location designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, texture and pattern are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.7 **DELIVERY, STORAGE, AND HANDLING**

A. Store products off the ground on pallets in manufacturer's unopened packaging until ready for installation.

B. Protect materials from precipitation and freezing temperatures. Product with visible frozen moisture should not be installed.

1.8 **PROJECT CONDITIONS**

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 **WARRANTY**
A. Provide manufacturers 50 year limited warranty against defects in manufacturing.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Cultured Stone® by Boral®, which is located at: 200 Mansell Court E. Suite 305; Roswell, GA 30076; Toll Free Tel: 800-255-1727; Tel: 866-557-8663; Email: boralstoneanswers@boral.com; Web: www.culturedstone.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 MANUFACTURED STONE

A. Cultured Stone Country Ledgestone:
   1. Heights: Variable from 1-1/2 inches to 6-1/2 inches (38 mm to 162 mm).
   2. Lengths: Variable from 4-3/4 inches to 22 inches (120 mm to 560 mm).

2.3 MORTAR

A. Pre Mixed Mortar: Complying with ASTM C270:
   1. Type: N

B. with ASTM C 150:
   1. Type I.

C. Mortar Aggregate: Complying with ASTM C 144, standard masonry type.

D. Hydrated Lime: Complying with ASTM C 207:
   1. Type S.

E. Water: Clean and potable.

2.4 ADDITIONAL MATERIALS

A. Wall Underlayment:
   2. Asphalt Saturated Felt meeting or exceeding the requirements of ASTM D 226 Type I.
   3. Weather Resistant Barrier meeting the requirements of ICC-ES AC-38.
   4. Water Resistive barrier meeting the requirements of ASTM E 2556/E 2556M.

B. Metal Flashing:
   1. 0.032 inch aluminum sheet; ASTM B 209.
   2. 24 gauge galvanized steel; ASTM A 653.
   3. 16 oz/sq ft (5 kg/sm) copper sheet; ASTM B 370.

C. Metal Lath: Diamond patterned steel mesh meeting or exceeding the requirements of ASTM C 847. Minimum 2.5 lb/sq yd (1.37 kg/sm).

PART 3 EXECUTION
3.1 EXAMINATION
   A. Do not begin installation until substrates have been properly prepared.
   B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION
   A. Clean surfaces thoroughly prior to installation.
   B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. General:
      2. Sills: Install Sills where located on the Drawings.
   C. Keep surfaces moist while installing.
   D. Poorly attached stones are considered defective work. After set-up, inspect wall for loose stones.
   E. Remove and properly replace prior to project close-out.
   F. Seal all joints at wall openings and penetrations with a sealant approved for use with masonry products.

3.4 PROTECTION
   A. Protect finished work from rain and work on either side of the wall during and for 48 hours following installation.
   B. Protect installed products until completion of project.
   C. Clean prior to project closeout.
   D. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION
SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Prefabricated building columns.
3. Field-installed shear connectors.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
3. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.
4. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for surface-preparation and priming requirements.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches (38 mm).
2. Welded built-up members with plates thicker than 2 inches (50 mm).
3. Column base plates thicker than 2 inches (50 mm).

D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the Seismic-Load-Resisting System.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

D. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, and testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:
   1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   2. Direct-tension indicators.
   3. Tension-control, high-strength, bolt-nut-washer assemblies.
   4. Shear stud connectors.
   5. Shop primers.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD[, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172)].

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE or Category CSE.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use Load and Resistance Factor Design; data are given at factored-load level or Allowable Stress Design; data are given at service-load level.

B. Moment Connections: Type FR, fully restrained.

C. Construction: Shear wall system] [Combined system of moment frame and braced frame] [Combined system of moment frame and shear walls] [Combined system of braced frame and shear walls] [Combined system of moment frame, braced frame, and shear walls].

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 572/A 572M, Grade 50 (345)
B. Channels, Angles, M, S-Shapes: ASTM A 572/A 572M, Grade 50 (345)
C. Plate and Bar: ASTM A 572/A 572M, Grade 50 (345)
D. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50 (345).

E. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.

F. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.

G. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
   1. Weight Class: Standard.
   2. Finish: Black except where indicated to be galvanized.

H. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.

I. Steel Forgings: ASTM A 668/A 668M.

J. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
   1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.
   1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.

C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
   1. Finish: Hot-dip or mechanically deposited zinc coating.
   2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
   1. Finish: Mechanically deposited zinc coating.
E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

F. Unheaded Anchor Rods: ASTM F 1554, Grade 36
   5. Finish: Plain

G. Headed Anchor Rods: ASTM F 1554, Grade 36 straight.
   3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
   4. Finish: Plain

H. Threaded Rods: ASTM A 36/A 36M
   2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
   3. Finish: Plain

I. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

J. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.


L. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
   1. Mating Surfaces: PTFE and PTFE.
   2. Coefficient of Friction: Not more than 0.03 to 0.06 as required.
   3. Design Load: Not less than 2,000 psi (13.7 MPa)
   4. Total Movement Capability: 2 inches (50 mm).

2.4 PRIMER

A. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

B. Primer: SSPC-Paint 25, Type I zinc oxide, alkyd, linseed oil primer.

C. Primer: SSPC-Paint 25 BCS, Type I zinc oxide, alkyd, linseed oil primer.

D. Primer: SSPC-Paint 23, latex primer.
E. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

F. Galvanizing Repair Paint: ASTM A 780/A 780M.

2.5 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION


   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning", SSPC-SP 2, "Hand Tool Cleaning", and SSPC-SP 3, "Power Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.
H. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches (250 mm) o.c. unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened, Pre-tensioned, Slip critical, as required.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
   2. Surfaces to be field welded.
   4. Surfaces to receive sprayed fire-resistant materials (applied fireproofing).
   5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. SSPC-SP 2, "Hand Tool Cleaning."
   2. SSPC-SP 3, "Power Tool Cleaning."
   3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
   4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
   5. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
9. SSPC-SP 8, "Pickling."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels, shelf angles, and, welded door frames attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

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

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

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

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.


1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten or pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened, pre-tensioned, or slip critical as required.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs[ where indicated], back gouge, and grind steel smooth.

3.5 PREFABRICATED BUILDING COLUMNS

A. Install prefabricated building columns to comply with AISC 360, manufacturer's written recommendations, and requirements of testing and inspecting agency that apply to the fire-resistance rating indicated.
3.6 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections

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

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

C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

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

   a. Liquid Penetrant Inspection: ASTM E 165.
   b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
   c. Ultrasonic Inspection: ASTM E 164.
   d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.7 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."
SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   2. KCS-type K-series steel joists.
   4. LH- and DLH-series long-span steel joists.
   5. CJ-series composite steel joists.
   7. Joist accessories.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
   2. Section 051200 "Structural Steel Framing" for field-welded shear connectors.

1.3 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

   1. Include layout, designation, number, type, location, and spacing of joists.
   2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
   3. Indicate locations and details of bearing plates to be embedded in other construction.
1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer professional engineer.

B. Welding certificates.

C. Manufacturer certificates.

D. Mill Certificates: For each type of bolt.

E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

F. Field quality-control reports.

1.6 QUALITY ASSURANCE


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

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

1.7 DELIVERY, STORAGE, AND HANDLING


B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.8 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers include the following:

1. Vulcraft
2. Canan Steel Corporation
3. Valley Joist
4. Architect/Engineer accepted substitution

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
   1. Use ASD; data are given at service-load level.
   2. Design special joists to withstand design loads with live-load deflections no greater than the following:
      a. Floor Joists: Vertical deflection as indicated on Structural Drawings.
      b. Roof Joists: Vertical deflection as indicated on Structural Drawings.

2.3 K-SERIES STEEL JOISTS


B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

F. Do not camber joists.

G. Camber joists as indicated.

H. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.4 LONG-SPAN STEEL JOISTS

A. Manufacture steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated.

B. Provide holes in chord members for connecting and securing other construction to joists.
C. Camber long-span steel joists as indicated on Structural Drawings.

D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.5 COMPOSITE STEEL JOISTS


B. Camber composite steel joists as indicated on Structural Drawings.

2.6 JOIST GIRDERS

A. Manufacture joist girders according to "Standard Specification for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as indicated on Structural Drawings.

   1. End Arrangement: as indicated on Structural Drawings.

   2. Joist girders are available parallel, pitched one way, or pitched two ways. SJI's load tables are based on a standard pitch of 1/8 inch per 12 inches (1:96). Coordinate with roof-slope requirements.

   3. Top-Chord Arrangement: as indicated on Structural Drawings.

B. Provide holes in chord members for connecting and securing other construction to joist girders.

C. Camber joist girders as indicated on Structural Drawings.

D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.7 PRIMERS

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

B. Primer: Provide shop primer that complies with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

2.8 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" and "Standard Specification for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists,
Weight Tables and Bridging Tables, Code of Standard Practice" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.


D. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint.

E. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."

F. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch (13 mm) of finished wall surface unless otherwise indicated.

1. Finish: Plain, uncoated.

G. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.

1. Finish: Plain

H. Welding Electrodes: Comply with AWS standards.

I. Galvanizing Repair Paint: ASTM A 780/A 780M.

J. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.9 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick.

D. Shop priming of joists and joist accessories is specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications" and "Standard Specification for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice," joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads is applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.

E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

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

B. Visually inspect field welds according to AWS D1.1/D1.1M.
1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, at testing agency's option:

   a. Liquid Penetrant Inspection: ASTM E 165/E 165M.
   b. Magnetic Particle Inspection: ASTM E 709.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

3.4 PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

   1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2 or power-tool cleaning according to SSPC-SP 3.
   2. Apply a compatible primer of same type as primer used on adjacent surfaces.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

END OF SECTION 052100
SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Roof deck.
   2. Cellular roof deck.
   3. Acoustical roof deck.
   5. Composite floor deck.
   8. Noncomposite vented form deck.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
   2. Section 035216 "Lightweight Insulating Concrete" for lightweight insulating concrete fill over steel deck.
   3. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
   4. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
   5. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
   6. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Power-actuated mechanical fasteners.
   2. Acoustical roof deck.

D. Evaluation Reports: For steel deck, from ICC-ES.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.


C. Electrical Raceway Units: Provide UL-labeled cellular floor-deck units complying with UL 209 and listed in UL's "Electrical Construction Equipment Directory" for use with standard header ducts and outlets for electrical distribution systems.


1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
   1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ROOF DECK

A. Acceptable manufacturers include the following:

1. Canam Corporation
2. Cordeck
3. Nucor Corporation
4. Roof Deck Inc
5. Valley Joist Corporation
6. Architect/Engineer approved substitution

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

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), as indicated on Structural Drawings, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
   a. Color: Manufacturer's standard

2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), as indicated on Structural Drawings zinc coating.
3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), as indicated on Structural Drawings, zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

4. Aluminum-Zinc-Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 33 (230) minimum, AZ50 (AZ150) aluminum-zinc-alloy coating.
5. Deck Profile: as indicated on Structural Drawings
6. Cellular Deck Profile: as indicated on Structural Drawings, with bottom plate.
7. Profile Depth: as indicated on Structural Drawings Retain one steel thickness in "Design Uncoated-Steel Thickness" Subparagraph below or revise to suit Project.
8. Design Uncoated-Steel Thickness: as indicated on Structural Drawings
9. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: as indicated on Structural Drawings. Retain span used in design from "Span Condition" Subparagraph below.
10. Span Condition: as indicated on Structural Drawings
11. Side Laps: as indicated on Structural Drawings
2.3 **ACCESSORIES**

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile as indicated on Structural Drawings.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, as indicated on Structural Drawings.

J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

K. Recessed Sump Pans: Single-piece steel sheet, as indicated on Structural Drawings.

L. Galvanizing Repair Paint: ASTM A 780/A 780M.

M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

**PART 3 - EXECUTION**

3.1 **EXAMINATION**

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

   1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:

   1. Weld Diameter: as indicated on Structural Drawings.
   2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated on Structural Drawings.
   3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or as indicated on Structural Drawings, and as follows:

   1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
   2. Mechanically clinch or button punch.
   3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.
C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
   1. End Joints: as indicated on Structural Drawings.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck as indicated on structural drawings.
   1. Install reinforcing channels or zees in ribs to span between supports as indicated on Structural Drawings.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions.
   1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY CONTROL

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

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
   1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
   2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting” and Section 099123 "Interior Painting."

END OF SECTION 053100
SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Floor joist framing.
4. Roof rafter framing.
5. Ceiling joist framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.
2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
3. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing.
1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
   1. Steel sheet.
   2. Expansion anchors.
   4. Mechanical fasteners.
   5. Vertical deflection clips.
   6. Horizontal drift deflection clips
   7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

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

D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

1.7 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers include the following:
   1. Craco Manufacturing
   2. MBA Building Supplies
   3. United Steel Deck Inc.
2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: As indicated.
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than indicated on the Structural Drawings.
   3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
   4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. Upward and downward movement as indicated on the Structural Drawings.
   5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Design Standards:
   2. Wall Studs: AISI S211.
   3. Headers: AISI S212.

D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as indicated on the Structural Drawings.

B. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as indicated on Structural Drawings.
2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as indicated on Structural Drawings.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as indicated on Structural Drawings.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as indicated on Structural Drawings.

D. Steel Single- or Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as indicated on Structural Drawings.

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as indicated on Structural Drawings.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as indicated on Structural Drawings.

C. Vertical Deflection Clips: Manufacturer's standard [bypass] [head] clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as indicated on Structural Drawings.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

   1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as indicated on Structural Drawings.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 FLOOR JOIST FRAMING

A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, with stiffened flanges, and as indicated on Structural Drawings.
B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as indicated on Structural Drawings.

2.7 ROOF-RAFTER FRAMING

A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as indicated on Structural Drawings.

2.8 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as indicated on Structural Drawings.

2.9 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as indicated on Structural Drawings.

2.10 FRAMING ACCESSORIES

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

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
9. Joist hangers and end closures.

2.11 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade as indicated on Structural Drawings.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or
equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

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

F. Welding Electrodes: Comply with AWS standards.

2.12 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: per ASTM A 780.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

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

D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

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

2.13 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

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

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

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 PREPARATION

A. Before sprayed fire-resistant materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistant materials.

B. After applying sprayed fire-resistant materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistant materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistant materials from damage.

C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

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

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

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

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

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

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

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

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
   1. Anchor Spacing: As shown on Shop Drawings.
B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:

1. Stud Spacing: As indicated.
2. Stud Spacing: As indicated.

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

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically as indicated as indicated on Shop Drawings. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

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

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: As indicated.
   2. Stud Spacing: As indicated.

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

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single deep-leg deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to studs and anchor to building structure.
   4. Connect drift clips to cold-formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
   1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) to 18 inches (450 mm)] of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
      a. Install solid blocking at centers indicated on Shop Drawings.
   2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
   3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
   4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 JOIST INSTALLATION

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

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

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

D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.
   1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
   1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
   2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

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

3.8 REPAIRS AND PROTECTION

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

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000
SECTION 054400 - COLD-FORMED METAL TRUSSES

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Cold-formed steel trusses for roofs.
   2. Cold-formed steel trusses for floors.
B. Related Requirements:
   1. Section 054000 "Cold-Formed Metal Framing" for cold-formed steel studs, joists, and rafters.

1.3 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel trusses; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
C. Delegated-Design Submittal: For cold-formed steel trusses.

1.5 INFORMATIONAL SUBMITTALS
A. Qualification Data: For testing agency.
B. Welding certificates.
C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
   1. Steel sheet.
   2. Expansion anchors.
   4. Mechanical fasteners.
   5. Miscellaneous structural clips and accessories.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

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

1.7 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers include the following:
   1. TrusSteel Corp
   2. WESTCO
   3. Vulcraft
   4. Architect/Engineer approved Substitution

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel trusses capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: As indicated.
2. Deflection Limits: Design trusses to withstand design loads without deflections greater than as indicated on Structural Drawings.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).

C. Cold-Formed Steel Framing Design Standards:

1. Floor and Roof Systems: Design according to AISI S210.
2. Lateral Design: Design according to AISI S213.
3. Roof Trusses: Design according to AISI S214.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL TRUSS MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, structural grade, Type H, metallic coated, of grade and coating weight as indicated on Structural Drawings.

2.4 ROOF TRUSSES

A. Roof Truss Members: Manufacturer's standard steel sections as indicated on Structural Drawings.

2.5 FLOOR TRUSSES

A. Floor Truss Members: Manufacturer's standard steel sections as indicated on Structural Drawings.

2.6 ACCESSORIES

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

B. Provide accessories of manufacturer's standard thickness and configuration unless otherwise indicated.

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
B. Anchor Bolts: ASTM F 1554, as indicated on Structural Drawings.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and Appendix D in ACI 318, greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Power-Actuated Fasteners: Fastener system of type suitable for application, fabricated from corrosion-resistant materials, with capability to sustain, without failure, allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

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

F. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

B. Shims: Load bearing, of high-density multimonomer plastic, nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

2.9 FABRICATION

A. Fabricate cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate trusses using jigs or templates.
   2. Cut truss members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel truss members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   4. Fasten other materials to cold-formed steel trusses by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

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

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting cold-formed steel trusses for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed steel trusses without reducing thickness of fire-resistive materials below that is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. Install, bridge, and brace cold-formed steel trusses according to AISI S200, AISI S214, AISI's "Code of Standard Practice for Cold-Formed Steel Structural Framing," and manufacturer's written instructions unless more stringent requirements are indicated.

B. Install cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened.

1. Fasten cold-formed steel trusses by welding or mechanical fasteners.
   a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings; comply with requirements for spacing, edge distances, and screw penetration.

C. Install temporary bracing and supports. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

D. Truss Spacing: as indicated on Structural Drawings.

E. Do not alter, cut, or remove framing members or connections of trusses.
F. Erect trusses with plane of truss webs plumb and parallel to each other, align, and accurately position at spacings indicated.

G. Erect trusses without damaging framing members or connections.

H. Coordinate with wall framing to align webs of bottom chords and load-bearing studs or continuously reinforce track to transfer loads to structure. Anchor trusses securely at all bearing points.

I. Install continuous bridging and permanently brace trusses as indicated on Shop Drawings and designed according to CFSEI's TechNote 551e, "Design Guide: Permanent Bracing of Cold-Formed Steel Trusses."

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

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

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the special inspections as indicated on Structural Drawings.

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

C. Field and shop welds will be subject to testing and inspecting.

D. Prepare test and inspection reports.

3.5 REPAIRS AND PROTECTION

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

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal trusses are without damage or deterioration at time of Substantial Completion.

END OF SECTION 054400
PART 1 - GENERAL

1.01 DESCRIPTION

Work includes, but is not necessarily limited to, steel supports/hangers, bollards, miscellaneous iron and steel fabrications.

1.02 SUBMITTALS

A. Shop Drawings: Within 21 days of contract award, submit complete shop drawings of all items proposed to be furnished and installed in this Section for Architect’s review per provision of Section 01300.

B. Mill Test Reports: Provide reports and certification, including related heat or melt numbers, to demonstrate compliance with specified requirements.

C. Testing/Inspection
   1. Certified inspections and certification of all shop and field welding shall be provided per referenced standards.
   2. Testing of all products not provided with mill test reports shall be per applicable ASTM standards.

D. Product Data: Product data for material used in miscellaneous metal fabrications, including paint products and grout.

1.03 REFERENCES

A. Applicable or referenced section of AISC Manual of Steel Construction, current edition.

B. Applicable or referenced sections of AWS D1.1 standards

1.04 QUALITY ASSURANCE

A. Staff: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Engineer Qualifications: Professional engineer licensed to practice in jurisdiction where project is located and experienced in providing engineering services of the kind indicated that have resulted in the successful installation of metal fabrication similar in material, design, and extent to that indicated for the Project.

1.05 PROJECT CONDITIONS

A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on the final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

B. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

1.06 DELIVERY AND STORAGE OF MATERIALS AND ASSEMBLIES

A. Delivery
1. General: Deliver all materials and finished assemblies in an undamaged condition. Off-load in such a manner as to avoid stress on joints, connections, or frames.

B. Storage
   1. Store all materials and assemblies in an acceptable manner, maintaining specified finish without damage from weather, traffic or work in progress.
   2. Damaged or deteriorated materials or assemblies shall not be used.

PART 2 - PRODUCTS

2.01 STRUCTURAL STEEL SHAPES
   A. Metal Surfaces, General: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.

   B. Steel Shapes: Steel plates, shapes, and bars: ASTM A36.

   Rolled Steel Floor Plates: ASTM A786.

   Steel Bars for Gratings: ASTM A611, Grade A

   Galvanized Steel Sheet: ASTM A446, Grade A.

   Reinforcing Bars: ASTM A615, Grade 60 and Grade 40.

   Comply with ASTM A36 for all steel shapes, clips, angles & related components and fabrications.

2.02 STEEL PIPES AND TUBING
   A. Pipe: Comply with ASTM A53 Type E or S, Grade B. Provide standard weight (Schedule 40), black finish except where galvanizing is specified, unless otherwise indicated. All pipe located at exterior shall be hot dip galvanized.

   B. Tubing: Provide tubing complying with ASTM A500, Grade B, with ¼” minimum wall thickness or as shown on drawings. All exterior tubing shall be hot dip galvanized.

2.03 MALLEABLE IRON CASTINGS
   A. Comply with ASTM A47, Grade 32510

2.04 BRACKETS, FLANGES AND ANCHORS
   A. Provide cast or formed metal of same type material and finish as supported members, unless otherwise noted.

2.05 FASTENERS
   A. General
      1. Provide hot dip galvanized fasteners for fastening at ferrous metals, exterior use and where built into exterior walls. Select fasteners for the type, grade, and class required.

   B. Standards
      1. Bolts and nuts: Regular hexagon-head type, ASTM A307, Grade A. Moment frames use ASTM A325 per drawing.
5. Headed studs: “Nelson Studs” as manufactured by Nelson Division of TRW.

2.06 SIGN POSTS
A. All steel posts and pipe sleeves shall be steel, per ASTM A53, galvanized Grade B, standard weight.

2.07 WELDING
A. Welding Rod: Conforming with American Welding Society “Specifications for Arc Welding Electrodes: of classification numbers suitable to the work to be done.
B. Weld behind finished surfaces to minimize distortion and discoloration on finished side. Remove weld splatter and welding oxides from finished surfaces by descaling and grinding. Grind and polish weld beads on exposed surfaces to match and blend with finish on adjacent parent metal.

2.08 PRIMER PAINT
A. Shop Primed Steel: Shop prime steel items not indicated to be galvanized. Remove loose mill scale and rust from structural steel and remove mill scale and rust from ornamental metal. Thoroughly clean to remove oil, grease, dirt & other foreign material and apply one shop coat of rust-inhibitive primer containing at least 50% rust inhibitive pigments. Carefully apply paint to provide smooth and even surface.

2.09 GALVANIZING
A. All exterior steel inserts, sleeves, and related products shall be hot dip galvanized per ASTM A123, A153 and A385. All fasteners and connection components shall be hot dip galvanized per ASTM A153.

2.10 GALVANIZING REPAIR PAINT
A. High zinc dust content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint-20.

2.11 BITUMINOUS COATING
A. Cold applied asphalt mastic, complying with SSPC Paint-12 except containing no asbestos fibers, compounded for 30-mil thickness.

2.12 CONCRETE INSERTS
A. Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A27. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A153.

2.13 (NOT USED)

2.14 OTHER MATERIALS
A. All other materials not specifically described but required for a complete and proper installation shall be provided by the Contractor, subject to approval of the Architect.

PART 3 - EXECUTION

3.01 SURFACES VERIFICATION
A. Inspection
   1. Prior to work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
   2. Verify that products may be installed in accordance with the original design, all pertinent codes and regulations and the referenced standards.

B. Discrepancies
   1. In the event of discrepancy, immediately notify the Architect.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 GENERAL FABRICATION AND INSTALLATION

A. General
1. Metal fabrications in finished spaces shall be considered ornamental metal. Metal shall be smooth and free of surface blemishes including roughness, pitting, roller and seam marks, and rolled trade names.
2. Ferrous metal work shall conform to applicable provisions of standards, rules and practices as set forth in the current Edition of the Manual of Steel Construction issued by A.I.S.C.
3. All details shown are typical. Similar details apply to similar conditions. Structural drawings shall be checked with the architectural drawings for dimensions, elevations, size and locations of all installations. All dimensions shall be verified at the job. Built-in or cast-in items shall be supplied in ample time for incorporation in the work. Include all reinforcing angles, plates, straps, brackets, hangers, clips, lugs, holes, shims, etc., as shown or required for erection of work and as required to complete the work as shown on the Drawings.

3.03 SHOP FABRICATION AND ASSEMBLY

A. All materials shall be fabricated and assembled in the shop to the greatest extent possible. Shearing, flame cutting & chipping shall be done carefully and accurately. Assembled pieces shall be taken apart, if necessary, for the removal of burns and shavings produced by reaming operations. Coordinate all connection details to concrete. Schedule and coordinate work under this Section with that specified elsewhere in order to produce a workmanlike installation satisfactory to Architect. Finished surfaces of all exposed members shall be smooth and free of any markings, burns, or other defects.

3.04 CONNECTIONS

A. Connections shall be bolted or welded as indicated. Connections not indicated shall conform with the applicable requirements of AISC “Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings.”

3.05 HOLES

A. Holes shall be cut, drilled or punched at right angles to the surface of the metal and shall not be made or enlarged by burning. Holes in base or bearing plates shall be drilled. Holes shall be provided in members to permit connecting the work of other trades. Holes shall be clean-cut without torn or ragged edges. Outside burns resulting from drilling or reaming operations shall be removed with a tool making a 1/16” bevel. Bolt holes shall be 1/16” oversize.

3.06 WELDING

A. Specifications: Fabrication shall be in accordance with the current Code for Fusion Welding and Sea Cutting in Building Construction, issued by American Welding Society, for electric shielded arc process.

B. Welders: Only experienced operators who have previously qualified by test as prescribed in the “Qualifications Procedures” of the American Welding Society shall execute welded structural steel construction.

C. General: Place welds on clean, unoxidized metal surface, free of scale or foreign matter; free of overlaps, undercrusts or craters and showing good fusion & penetration. Remove defective welds by chipping and replace as instructed.
1. Fillet and butt welds shall be made with such a number of passes of beads as may be necessary to secure sound and thoroughly fused joints, but each deposit shall not exceed 1/8” of weld for each bead or pass. Preceding layers shall be thoroughly cleaned and wire-brushed to remove all scale and slag before succeeding layers are placed.
2. All welds exposed in the finish work shall be located in the least conspicuous place, ground and dressed smooth so that the shape and profile of the item welded is preserved.
3. All work to be welded shall be placed in jigs, forms or other methods employed to prevent buckling, raising or other apparent finish marring resulting from welding.

3.07 BOLTED CONNECTIONS
A. General
   1. Bolts or machine screws shall be finished, unless otherwise shown. Provide all bolts with washers under nuts, with unthreaded shanks extending a minimum of one-half way through the joined part nearest the nut. Use countersunk, Phillips, flat or oval-headed screws for exposed bolted connections in finished spaces.
   2. Remove excess threaded length.

3.08 BASES, BEARING PLATES AND ANCHORS
A. For items bearing on concrete or masonry, provide steel bearing plates and anchors as indicated. Templates shall be furnished, together with instructions for setting of anchors, anchor bolts and bearing plates. Contractor shall supervise and ascertain that anchors and related items are properly set in concrete or masonry during the progress of the work.

3.09 ERRECTION AN INSTALLATION
A. General: A sufficient number of skilled mechanics shall be furnished to handle the work expeditiously and all work shall be erected at such time and in such manner as to be completed within the shortest period of time practicable. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately to the Architect and approval of the method of correction shall be obtained. Approved corrections shall be made at no additional cost to the Owner. Field welding shall conform to the requirements specified in paragraph 3.06, with certified inspection required.

     B. Lines and Levels: Metal work shall be set accurately at the established lines and levels, before bolting is commenced. Installation shall be in strict accordance with approved drawings and actual conditions. Verify compliance with all codes required at all conditions prior to final installation.

     C. Temporary Bracing: Temporary bracing shall be provided as required and must be kept in position until final completion. Shop fabricated items subject to damage shall be braced and carefully handled to prevent distortion or other damage.

     D. Anchor Bolts and Anchors: Anchor bolts and anchors shall be properly located and inserted or built into connecting work. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.

     E. Field Assembly:
        1. After assembly, the various members forming parts of a completed frame or structure shall be aligned and adjusted accurately before being fastened. Tolerance shall conform to the applicable requirements of AISC “Code of Standard Practice”. Bearing surfaces that will be in permanent contact shall be cleaned before the members are assembled. As erection progress, the work shall be securely fastened to resist all dead load, wind load, and erection stresses. Splices will be permitted only where indicated.
        2. Install railing per approved shop drawings. Verify code required clearance and spacing limitations before final alignment.
        3. Grout all railing inserts with specified product and as shown on drawings. Prepare for sealant specified in Section 07900.

     F. Installation
        1. Frames for equipment mounted on roof or hung from structure shall impart loads to purlins or girders only, unless indicated otherwise.
2. Protect aluminum in contact with steel metal fabrications from galvanic and corrosive action with bituminous coating applied prior to erection.

3. Where railings are shown anchored in sleeves preset in concrete, install posts in sleeves and grout solid. Where core drilling is indicated, drill holes, install posts and grout solid. Apply grout according per manufacturer’s instructions. For installation exposed to water or exterior, seal exposed grout according to manufacturer’s instructions.

4. Where posts or rail ends are to be flange anchored, weld ends to steel oval or round flanges. Secure flange to supporting surface by welding, bolting or expansion anchors as required.

5. Install wall mounted handrails to support a minimum load of 200 pounds applied at any point in any direction.

3.10 PAINTING (PRIMER)
A. Miscellaneous Iron Not Galvanized
   1. Thoroughly clean metal, by effective means, of all loose mill scale, rust and foreign matter before painting.
   2. Paint: Shop prime with one coat of approved primer.
   3. Unless otherwise specified, do not paint galvanized work.
   4. Touching up: After erection, touch-up all field connections, abraded planes and welds with paint. Paint all parts not accessible after assembly. Make paint on all members free of skips, runs and sags in order that the surface be in proper condition to receive the final coat of paint.
   5. Encased steel: Do not paint steel encased in concrete.

3.11 GALVANIZING
A. General: All exterior metal fabrications, railings, inserts, sleeves, all fasteners, and miscellaneous components shall be hot dip galvanized per the following requirements.

B. Preparation and Galvanizing
   1. All fabrications, components, bolts, nuts, washers, and items of iron and steel hardware furnished for galvanizing shall be suitable for hot dip galvanizing. Verify that design configuration is suitable for galvanizing.
   2. Inspect products before galvanizing and ascertain whether suitable for galvanizing. Replace items which are not suitable for galvanizing.
   3. All zinc shall conform with ASTM B 6, as specified in ASTM A123.
   4. Galvanizing
      a. Steel members, fabrications and assemblies shall be galvanized by hot dip process in accordance with ASTM A-123, A 153 and A 385 as applicable. Weight of zinc coating to conform to requirements specified under “Weight of Coating” in ASTM A 123 or ASTM A 385, as applicable.
      b. Safeguard against steel embrittlement in conformance with ASTM A 143.
      c. Safeguard against warpage or distortion of steel members to conform with ASTM A384. Notify Architect of potential warpage problems which may require modification in design, before proceeding with steel fabrications.
      d. Finish and uniformity of zinc coating and adherence of coating shall conform with ASTM A123, A153 or A385, as applicable.
      e. Bolts, nuts, and washers, and iron and steel hardware components shall be galvanized in accordance with ASTM A153. Weight of zinc coating to conform to requirements specified under “Weight of Coating” in ASTM A 153. Nuts shall be tapped after galvanizing to minimum diametral amounts specified in ASTM A564. Coat nuts with waterproof lubricant, clan and dry to tough. High strength bolts for structural steel joints shall be galvanized in accordance with ASTM A 325.
      f. Galvanized materials subject to extended periods of storage in open, exterior locations shall be given passivating treatment of light oiling to prevent humid storage stain. Treatment, solution and process subject to review and acceptance by Architect/Engineer. Chromate passivation shall not be used on items galvanized after fabrication and are to be painted after erection.
g. Preservative Oils: Do not treat freshly galvanized or passivated surface with oils, grease or chemicals which might interfere with adhesion of subsequent paint primers and coatings.

C. Repair: Repair all installation damage to galvanized coating with specified product.

3.12 CLEAN-UP

Upon completion of steel work, after inspection and approval of same, remove from site all waste, false-work, equipment, etc.

END OF SECTION 05500
SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Framing with dimension lumber.
   2. Framing with timber.
   3. Framing with engineered wood products.
   4. Shear wall panels.
   5. Rooftop equipment bases and support curbs.
   6. Wood blocking, cants, and nailers.
   7. Wood furring and grounds.
   8. Wood sleepers.

B. Related Requirements:
   1. Section 061063 "Exterior Rough Carpentry."
   2. Section 061323 "Heavy Timber Construction."
   3. Section 061533 "Wood Patio Decking" for elevated decks, including support framing.
   4. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.
   5. Section 061753 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.
   6. Section 313116 "Termite Control" for site application of borate treatment to wood framing.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.
C. Exposed Framing: Framing not concealed by other construction.
D. OSB: Oriented strand board.
E. Timber: Lumber of 5 inches nominal (114 mm actual) size or greater in least dimension.
1.4 ACTION SUBMITTALS

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

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Shear panels.
5. Power-driven fasteners.
6. Post-installed anchors.
7. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

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

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less; 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

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

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

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

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

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

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

1. For exposed lumber indicated to receive a stained or natural finish.
D. Application: Treat all rough carpentry unless otherwise indicated. Items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

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

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

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

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.

E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
F. Application: Treat all rough carpentry unless otherwise indicated. Items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Framing for stages.
3. Concealed blocking.
4. Framing for non-load-bearing partitions.
5. Framing for non-load-bearing exterior walls.
6. Roof construction.
7. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Standard, Stud, or No. 3 grade.

1. Application: Interior partitions not indicated as load bearing.
2. Species:
   a. Hem-fir (north); NLGA.
   b. Southern pine or mixed southern pine; SPIB.
   c. Spruce-pine-fir; NLGA.
   d. Hem-fir; WCLIB, or WWPA.
   e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   f. Northern species; NLGA.
   g. Eastern softwoods; NeLMA.
   h. Western woods; WCLIB or WWPA.

B. Load-Bearing Partitions: Construction, Stud, or No. 3 grade.

2. Species:
   a. Hem-fir (north); NLGA.
   b. Southern pine; SPIB.
   c. Douglas fir-larch; WCLIB or WWPA.
   d. Southern pine or mixed southern pine; SPIB.
   e. Spruce-pine-fir; NLGA.
   f. Douglas fir-larch; WWPA.
   g. Hem-fir; WCLIB or WWPA.
   h. Douglas fir-larch (north); NLGA.
   i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. Load-Bearing Partitions: Any species of machine stress-rated dimension lumber with a grade of not less than 2400F-2.0E.


D. Load-Bearing Partitions: Any species and grade with a modulus of elasticity of at least 1,500,000 psi (10350 MPa) and an extreme fiber stress in bending of at least 1000 psi (6.9
MPa) for 2-inch nominal (38-mm actual) thickness and 12-inch nominal (286-mm actual) width for single-member use.


E. Ceiling Joists: Standard, Stud, or No. 3 grade.

1. Species:
   a. Hem-fir (north); NLGA.
   b. Southern pine; SPIB.
   c. Douglas fir-larch; WCLIB or WWPA.
   d. Douglas fir-larch (north); NLGA.
   e. Southern pine or mixed southern pine; SPIB.
   f. Spruce-pine-fir; NLGA.
   g. Hem-fir; WCLIB or WWPA.
   h. Douglas fir-south; WWPA.
   i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   j. Northern species; NLGA.
   k. Eastern softwoods; NeLMA.
   l. Western woods; WCLIB or WWPA.

F. Joists, Rafters, and Other Framing Not Listed Above: Construction, Stud, or No. 3 grade.

1. Species:
   a. Hem-fir (north); NLGA.
   b. Southern pine; SPIB.
   c. Douglas fir-larch; WCLIB or WWPA.
   d. Southern pine or mixed southern pine; SPIB.
   e. Spruce-pine-fir; NLGA.
   f. Douglas fir-south; WWPA.
   g. Hem-fir; WCLIB or WWPA.
   h. Douglas fir-larch (north); NLGA.
   i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

G. Joists, Rafters, and Other Framing Not Listed Above: Any species of machine stress-rated dimension lumber with a grade of not less than 2400f-2.0E.

H. Joists, Rafters, and Other Framing Not Listed Above: Any species and grade with a modulus of elasticity of at least 1,500,000 psi (10 350 MPa) and an extreme fiber stress in bending of at least 1000 psi (6.9 MPa) for 2-inch nominal (38-mm actual) thickness and 12-inch nominal (286-mm actual) width for single-member use.

I. Exposed Framing Indicated to Receive a Stained or Natural Finish: Hand-select material for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

1. Species and Grade: As indicated above for load-bearing construction of same type.
2. Species and Grade: Hem-fir (north); Select Structural grade; NLGA.
3. Species and Grade: Southern pine; Select Structural grade; SPIB.
4. Species and Grade: Douglas fir-larch; Select Structural grade; WCLIB or WWPA.
5. Species and Grade: Mixed southern pine; Select Structural grade; SPIB.
6. Species and Grade: Spruce-pine-fir; Select Structural grade; NLGA.
7. Species and Grade: Douglas fir-south; Select Structural grade; WWPA.
8. Species and Grade: Hem-fir; Select Structural grade; WCLIB or WWPA.
9. Species and Grade: Douglas fir-larch (north); Select Structural grade; NLGA.
10. Species and Grade: Spruce-pine-fir (south); Select Structural grade; NeLMA, WCLIB, or WWPA.
11. Species and Grade: Eastern hemlock-balsam fir or eastern hemlock-tamarack; Select Structural grade; NeLMA.
12. Species and Grade: Beech-birch-hickory; Select Structural grade; NeLMA.
13. Species and Grade: Northern red oak; Select Structural grade; NeLMA.
14. Species and Grade: Redwood; Select Structural grade; RIS.
15. Species and Grade: Mixed oak; Select Structural No. 1 grade; NeLMA.
16. Species and Grade: Mixed maple; Select Structural grade; NeLMA.
17. Species and Grade: Western cedars; Select Structural No. 1 grade; WCLIB or WWPA.

2.5 ENGINEERED WOOD PRODUCTS

A. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.

B. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.

C. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
   1. Extreme Fiber Stress in Bending, Edgewise: 2900 psi (20 MPa) for 12-inch nominal-(286-mm actual-) depth members.
   2. Modulus of Elasticity, Edgewise: 2,200,000 psi (15 100 MPa).

D. Wood I-Joists: Prefabricated units, I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural panel webs, let into and bonded to flanges. Comply with material requirements of and with structural capacities established and monitored according to ASTM D 5055.
   1. Web Material: Either OSB or plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1, Plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1 Plywood, complying with DOC PS 1, Exterior grade.
   2. Structural Properties: Depths and design values not less than those indicated.

E. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research or evaluation report for I-joists.
F. Insulated Rim Boards: Insulated product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research/evaluation report for I-joists.

2.6 SHEAR WALL PANELS

A. Wood-Framed Shear Wall Panels: Prefabricated assembly consisting of wood perimeter framing, tie downs, and Exposure I, Structural I plywood or OSB sheathing.

B. Steel-Framed Shear Wall Panels: Prefabricated assembly consisting of cold-formed galvanized-steel panel, steel top and bottom plates, and wood studs.

C. Allowable design loads, as published by manufacturer, shall meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.7 MISCELLANEOUS LUMBER

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

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

B. Dimension Lumber Items: Standard, Stud, or No. 3 grade lumber of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Western woods; WCLIB or WWPA.
7. Northern species; NLGA.
8. Eastern softwoods; NeLMA.

C. Utility Shelving: Lumber with 19 percent maximum moisture content of any of the following species and grades:

1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
2. Mixed southern pine or southern pine.
3. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
4. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:

1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
2. Mixed southern pine or southern pine.
3. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
4. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

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

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

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

2.8 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) to 3/4-inch (19-mm) nominal thickness as required.

2.9 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

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

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


2.10 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated or of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

   1. Use for interior locations unless otherwise indicated.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
   1. Use for wood-preservative-treated lumber and where indicated.

D. Stainless-Steel Sheet: ASTM A 666, Type 304 or Type 316 as required.
   1. Use for exterior locations and where indicated.

E. Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges at least 85 percent of joist depth.
   1. Thickness: 0.050 inch (1.3 mm) to 0.062 inch (1.6 mm) as required.

F. I-Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.
   1. Thickness: 0.050 inch (1.3 mm) to 0.062 inch (1.6 mm) as required.

G. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
   1. Strap Width: 1-1/2 inches (38 mm) to 2 inches (50 mm).
   2. Thickness: 0.050 inch (1.3 mm) to 0.062 inch (1.6 mm) as required.

H. Bridging: Rigid, V-section, nailless type, 0.050 inch (1.3 mm) thick, length to suit joist size and spacing.

I. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch (25 mm) above base and with 2-inch- (50-mm-) minimum side cover, socket 0.062 inch (1.6 mm) thick, and standoff and adjustment plates 0.108 inch (2.8 mm) thick.
J. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.
   1. Width: 3/4 inch (19 mm) to 1-1/4 inches (32 mm) as required.
   2. Thickness: 0.050 inch (1.3 mm) to 0.062 inch (1.6 mm) as required.
   3. Length: As indicated.

K. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches (38 mm) wide by 0.050 inch (1.3 mm) thick. Tie fastens to side of rafter or truss, face of top plates, and side of stud below.

L. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 2-1/4 inches (57 mm) wide by 0.062 inch (1.6 mm) thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.

M. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches (32 mm) wide by 0.050 inch (1.3 mm) thick by 36 inches (914 mm) long.

N. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.
   1. Bolt Diameter: 5/8 inch (15.8 mm) to 3/4 inch (19 mm) as required.
   2. Width: 2-1/2 inches (64 mm) to 3-3/16 inches (81 mm) as required.
   3. Body Thickness: 0.108 inch (2.8 mm) to 0.138 inch (3.5 mm) as required.
   4. Base Reinforcement Thickness: 0.108 inch (2.8 mm) to 0.239 inch (6.1 mm) as required.

O. Wall Bracing: T-shaped bracing made for letting into studs in saw kerf, 1-1/8 inches (29 mm) wide by 9/16 inch (14 mm) deep by 0.034 inch (0.85 mm) thick with hemmed edges.

P. Wall Bracing: Angle bracing made for letting into studs in saw kerf, 15/16 by 15/16 by 0.040 inch (24 by 24 by 1 mm) thick with hemmed edges.

2.11 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.

B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spun bonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

D. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
E. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

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

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

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

E. Install shear wall panels to comply with manufacturer's written instructions.

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

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

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

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

   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

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

   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.

   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal (38-mm actual) thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.

4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.

K. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

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

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

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

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

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

O. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

P. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with approved fastener patterns where applicable
2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

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

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

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

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

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring at 24 inches (610 mm) o.c.

C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at 16 inches (406 mm) o.c.

3.4 WALL AND PARTITION FRAMING INSTALLATION

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal (38-mm actual) thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.

B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal (89-mm actual) depth for openings 48 inches (1200 mm) and less in width, 6-inch nominal (140-mm actual) depth for openings 48 to 72 inches (1200 to 1800 mm) in width, 8-inch nominal (184-mm actual) depth for openings 72 to 120 inches (1800 to 3000 mm) in width, and not less than 10-inch nominal (235-mm actual) depth for openings 10 to 12 feet (3 to 3.6 m) in width.

2. For load-bearing walls, provide double-jamb studs for openings 60 inches (1500 mm) and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.

D. Provide diagonal bracing in exterior walls, at both walls of each external corner, at 45-degree angle, full-story height unless otherwise indicated. Use 1-by-4-inch nominal- (19-by-89-mm actual-) size boards, let-in flush with faces of studs metal wall bracing, let into studs in saw kerf.
3.5 FLOOR JOIST FRAMING INSTALLATION

A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches (38 mm) of bearing on wood or metal, or 3 inches (76 mm) on masonry. Attach floor joists as follows:

1. Where supported on wood members, by toe nailing or by using metal framing anchors.
2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.

B. Fire Cuts: At joists built into masonry, bevel cut ends 3 inches (76 mm) and do not embed more than 4 inches (102 mm).

C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches (1200 mm).

D. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than one-third depth of joist; do not locate closer than 2 inches (50 mm) from top or bottom.

E. Provide solid blocking of 2-inch nominal (38-mm actual) thickness by depth of joist at ends of joists unless nailed to header or band.

F. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches (102 mm) or securely tie opposing members together. Provide solid blocking of 2-inch nominal (38-mm actual) thickness by depth of joist over supports.

G. Anchor members paralleling masonry with 1/4-by-1-1/4-inch (6.4-by-32-mm) metal strap anchors spaced not more than 96 inches (2438 mm) o.c., extending over and fastening to three joists. Embed anchors at least 4 inches (102 mm) into grouted masonry with ends bent at right angles and extending 4 inches (102 mm) beyond bend.

H. Provide solid blocking between joists under jamb studs for openings.

I. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.

1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.

J. Provide bridging of type indicated below, at intervals of 96 inches (2438 mm) o.c., between joists.

1. Diagonal wood bridging formed from bevel-cut, 1-by-3-inch nominal- (19-by-64-mm actual-) size lumber, double-crossed and nailed at both ends to joists.
2. Steel bridging installed to comply with bridging manufacturer's written instructions.

3.6 CEILING JOIST AND RAFTER FRAMING INSTALLATION

A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate, and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal- (19-by-184-mm actual-) size or 2-by-4-inch nominal- (38-by-89-mm actual-) size stringers spaced 48 inches (1200 mm) o.c. crosswise over main ceiling joists.

B. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against valley rafters.

2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against hip rafter.

C. Provide collar beams (ties) as indicated or, if not indicated, provide 1-by-6-inch nominal- (19-by-140-mm actual-) size boards between every third pair of rafters, but not more than 48 inches (1219 mm) o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.

D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.7 TIMBER FRAMING INSTALLATION

A. Install timber beams with crown edge up and provide not less than 4 inches (102 mm) of bearing on supports. Provide continuous members unless otherwise indicated; tie together over supports as indicated if not continuous.

B. Where beams or girders are framed into pockets of exterior concrete or masonry walls, provide 1/2-inch (13-mm) airspace at sides and ends of wood members.

C. Install wood posts using metal anchors indicated.

D. Treat ends of timber beams and posts exposed to weather by dipping in water-repellent preservative for 15 minutes.

3.8 STAIR FRAMING INSTALLATION

A. Provide stair framing members of size, space, and configuration indicated or, if not indicated, to comply with the following requirements:

1. Size: 2-by-12-inch nominal (38-by-286-mm actual) size, minimum.


3. Notching: Notch rough carriages to receive treads, risers, and supports; leave at least 3-1/2 inches (89 mm) of effective depth.
4. Spacing: At least three framing members for each 36-inch (914-mm) clear width of stair.

B. Provide stair framing with no more than 3/16-inch (4.7-mm) variation between adjacent treads and risers and no more than 3/8-inch (9.5-mm) variation between largest and smallest treads and risers within each flight.

3.9 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

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

END OF SECTION 061000
SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
5. Subflooring.
6. Underlayment.
7. Sheathing joint and penetration treatment.

B. Related Requirements:

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

1.3 ACTION SUBMITTALS

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

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Sustainable Design Submittals:
1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:
   1. Wood-preservative-treated plywood.
   2. Fire-retardant-treated plywood.
   3. Foam-plastic sheathing.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   
   1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS


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

C. Factory mark panels to indicate compliance with applicable standard.
2.3 PRESERVATIVE-TREATED PLYWOOD

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

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat all plywood unless otherwise indicated and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

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

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201/D 3201M at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F (76 deg C) shall be not less than span ratings specified.

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

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

E. Application: Treat all plywood unless otherwise indicated.
1. Roof and wall sheathing within 48 inches (1220 mm) of fire walls.
2. Roof sheathing.
3. Subflooring and underlayment for raised platforms.

2.5 WALL SHEATHING

A. Plywood Sheathing: Either DOC PS 1 or DOC PS 2, Exterior, Exposure 1 as required.
   1. Span Rating: Not less than 16/0 to 48/24 as required.
   2. Nominal Thickness: Not less than 3/8 inch (9.5 mm) or 1/2 inch (13 mm) as required.

B. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1, Structural I sheathing.
   1. Span Rating: Not less than 16/0 to 48/24 as required.
   2. Nominal Thickness: Not less than 3/8 inch (9.5 mm) to 1/2 inch (13 mm).

C. Paper-Surfaced Gypsum Sheathing: ASTM C 1396/C 1396M, gypsum sheathing; with water-resistant-treated core and with water-repellent paper bonded to core's face, back, and long edges.
   1. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
   2. Edge and End Configuration: Square.
   3. Size: 24 by 96 inches (610 by 2438 mm) for horizontal, 48 by 96 inches (1219 by 2438 mm) for vertical installation.

D. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
   1. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
   2. Edge and End Configuration: Square.
   3. Size: 24 by 96 inches (610 by 2438 mm) for horizontal, 48 by 96 inches (1219 by 2438 mm) for vertical installation.

   1. Product: Subject to compliance with requirements, provide "Fiberock Sheathing with Aqua-Tough" by United States Gypsum Co.
   2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
   3. Edge and End Configuration: Square.
   4. Size: 24 by 96 inches (610 by 2438 mm) for horizontal, 48 by 96 inches (1219 by 2438 mm) for vertical installation.

F. Cementitious Backer Units: ASTM C 1325, Type A.
   1. Thickness: 5/8 inch (15.9 mm) or as indicated.

G. Fiberboard Sheathing: ASTM C 208, Type IV, Grade 2 (Structural) cellulosic fiberboard sheathing with square edges, 1/2 inch (13 mm) thick.

H. Extruded-Polystyrene-Foam Sheathing: ASTM C 578, Type IV, in manufacturer's standard lengths and widths with tongue-and-groove or shiplap long edges as standard with manufacturer.
   1. Thickness: 3/4 inch (19 mm) to 1 inch (25 mm) as required.
   2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.
I. Foil-Faced, Polyisocyanurate-Foam Sheathing: ASTM C 1289, Type I or Type II, Class 2, rigid, cellular, polyisocyanurate thermal insulation. Foam-plastic core and facings shall have a flame-spread index of 25 or less when tested individually.
   1. Thickness: 1/2 inch (13 mm) to 1 inch (25 mm) as required.
   2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

2.6 ROOF SHEATHING

A. Plywood Sheathing: Exterior, Structural I sheathing as required.
   1. Span Rating: Not less than 16/0 to 48/24 as required.
   2. Nominal Thickness: Not less than 1/2 inch (13 mm).

B. Oriented-Strand-Board Sheathing: Exposure 1, Structural I sheathing.
   1. Span Rating: Not less than 16/0 to 20/0 or as required.
   2. Nominal Thickness: Not less than 1/2 inch (13 mm) to 3/4 inch (19 mm).

2.7 PARAPET SHEATHING

A. Plywood Sheathing: Exterior, Structural I sheathing.
   1. Span Rating: Not less than 16/0 to 48/24 as required.
   2. Nominal Thickness: Not less than 15/32 inch (11.9 mm) to 1/2 inch (13 mm).

B. Oriented-Strand-Board Sheathing: Exposure 1, Structural I sheathing.
   1. Span Rating: Not less than 16/0 to 48/24 as required.
   2. Nominal Thickness: Not less than 7/16 inch (11.1 mm) to 3/4 inch (19 mm) as required.

C. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
   1. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
   2. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

D. Cementitious Backer Units: ASTM C 1325, Type A.
   1. Thickness: 1/2 inch (12.7 mm) to 5/8 inch (15.9 mm) as required.

2.8 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

A. Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: ASTM C 1289, Type V with DOC PS 2, Exposure 1 oriented strand board on one face.
   1. Polyisocyanurate-Foam Thickness: 1 inch (25 mm) to 4 inches (102 mm) as required.
   2. Oriented-Strand-Board Nominal Thickness: 7/16 inch (11.1 mm) to 5/8 inch (15.9 mm).

B. Vented, Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: ASTM C 1289, Type II, Class 1, with DOC PS 2, Exposure 1 oriented strand board adhered to spacers on one face.
   1. Polyisocyanurate-Foam Thickness: 1 inch (25 mm) to 4 inches (102 mm) as required.
2. Oriented-Strand-Board Nominal Thickness: 7/16 inch (11.1 mm) to 5/8 inch (15.9 mm).
3. Spacers: Wood furring strips or blocks not less than 3/4 inch (19 mm) thick and spaced not more than 24 inches (600 mm) o.c.

2.9 SUBFLOORING AND UNDERLAYMENT

A. Plywood Combination Subfloor-Underlayment: Exposure 1, Structural I, Underlayment single-floor panels.
   1. Span Rating: Not less than 16 to 48/24 as required.
   2. Nominal Thickness: Not less than 23/32 inch (18.3 mm) to 1 inch (25 mm).
   3. Edge Detail: Square.

B. Oriented-Strand-Board Combination Subfloor-Underlayment: DOC PS 2, Exposure 1 single-floor panels.
   1. Span Rating: Not less than 16 to 48/24 as required.
   2. Nominal Thickness: Not less than 23/32 inch (18.3 mm) to 1 inch (25 mm).
   3. Edge Detail: Square.

C. Plywood Subflooring: Exterior, Structural I single-floor panels or sheathing.
   1. Span Rating: Not less than 16 to 48/24 as required.
   2. Nominal Thickness: Not less than 23/32 inch (18.3 mm) to 1 inch (25 mm) as required.

D. Oriented-Strand-Board Subflooring: DOC PS 2, Exposure 1, Structural I sheathing.
   1. Span Rating: Not less than 16 to 60/32 as required.
   2. Nominal Thickness: Not less than 23/32 inch (18.3 mm) to 1 inch (25 mm) as required.

E. Underlayment: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/4 inch (6.4 mm) over smooth subfloors and not less than 3/8 inch (9.5 mm) over board or uneven subfloors.
   1. Plywood Underlayment for Resilient Flooring: Exterior A-C or Exposure 1 Underlayment with fully sanded face.
   2. Plywood Underlayment for Ceramic Tile: DOC PS 1, Exterior, C-C Plugged, not less than 5/8-inch (15.9-mm) nominal thickness.
   3. Plywood Underlayment for Carpet: DOC PS 1, Exposure 1, Underlayment or Interior, Underlayment as required.
   4. Particleboard Underlayment: ANSI A208.1, Grade PBU or Grade M-2 as required.
   5. Hardboard Underlayment: ANSI A135.4, Class 4 (Service), Surface S1S; with back side sanded.
2.10 FASTENERS

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

1. For roof, parapets, and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
2. For roof, parapets, and wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

B. Nails, Brads, and Staples: ASTM F 1667.

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

D. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.

G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

2.11 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Paper-Surfaced or Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."

B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

2.12 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 or ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

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

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

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

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

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

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

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


B. Fastening Methods: Fasten panels as indicated below:

1. Combination Subfloor-Underlayment:
   a. Glue and nail to wood framing.
   b. Screw to cold-formed metal framing.
   c. Space panels 1/8 inch (3 mm) apart at edges and ends.

2. Subflooring:
   a. Glue and nail to wood framing.
   b. Screw to cold-formed metal framing.
   c. Space panels 1/8 inch (3 mm) apart at edges and ends.

3. Wall and Roof Sheathing:
   a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
   b. Screw to cold-formed metal framing.
   c. Space panels 1/8 inch (3 mm) apart at edges and ends.

4. Underlayment:
   a. Nail to subflooring.
   b. Space panels 1/32 inch (0.8 mm) apart at edges and ends.
   c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to wood framing with nails or screws.
2. Fasten gypsum sheathing to cold-formed metal framing with screws.
3. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
4. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.4 CEMENTITIOUS BACKER UNIT INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 FIBERBOARD SHEATHING INSTALLATION

A. Comply with ASTM C 846 and with manufacturer's written instructions.

B. Fasten fiberboard sheathing panels to intermediate supports and then at edges and ends. Use galvanized roofing nails; comply with manufacturer's recommended spacing and referenced fastening schedule. Drive fasteners flush with surface of sheathing and locate perimeter fasteners at least 3/8 inch (9.5 mm) from edges and ends.

C. Install sheathing vertically with long edges parallel to, and centered over, studs. Install solid wood blocking where end joints do not occur over framing. Allow 1/8-inch (3-mm) open space between edges and ends of adjacent units. Stagger horizontal joints if any.

D. Cover sheathing as soon as practical after installation to prevent deterioration from wetting.

3.6 FOAM-PLASTIC SHEATHING INSTALLATION

A. Comply with manufacturer's written instructions.
B. Foam-Plastic Wall Sheathing: Install vapor-relief strips or equivalent for permitting escape of moisture vapor that otherwise would be trapped in stud cavity behind sheathing.

C. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

3.7 PARTICLEBOARD UNDERLAYMENT INSTALLATION

A. Comply with CPA's recommendations for type of subfloor indicated. Fill and sand gouges, gaps, and chipped edges. Sand uneven joints flush.

1. Fastening Method: Glue and nail underlayment to subflooring.

3.8 HARDBOARD UNDERLAYMENT INSTALLATION

A. Comply with CPA's recommendations and hardboard manufacturer's written instructions for preparing and applying hardboard underlayment.

1. Fastening Method: Nail underlayment to subflooring.

END OF SECTION 061600
SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Interior trim, including nonfire-rated interior door and sidelight frames.
      2. Fire-rated interior door and sidelight frames.
   B. Related Requirements:
      1. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not
         exposed to view and for framing exposed to view.
      2. Section 061053 "Miscellaneous Rough Carpentry" for furring, blocking, and other
         carpentry work not exposed to view.
      3. Section 064300 "Wood Stairs and Railings."
      4. Section 099123 "Interior Painting" for priming and backpriming of interior finish
         carpentry.

1.3 DEFINITIONS
   A. MDF: Medium-density fiberboard.
   B. MDO: Plywood with a medium-density overlay on the face.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of process and factory-fabricated product. Indicate component
      materials, dimensions, profiles, textures, and colors and include construction and application
      details.
      1. Include data for wood-preservative treatment from chemical-treatment manufacturer and
         certification by treating plant that treated materials comply with requirements. Indicate
         type of preservative used and net amount of preservative retained. Include chemical-
         treatment manufacturer's written instructions for finishing treated material.
      2. Include data for fire-retardant treatment from chemical-treatment manufacturer and
         certification by treating plant that treated materials comply with requirements.
      3. For products receiving a waterborne treatment, include statement that moisture content of
         treated materials was reduced before shipment to Project site to levels specified.
B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

C. Samples for Verification:

1. For each species and cut of lumber and panel products with non-factory-applied finish, with half of exposed surface finished, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.
2. For foam plastic moldings, with half of exposed surface finished; 50 sq. in. (300 sq. cm).
3. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.
4. For interior wood columns, include quarter-section Sample of cap, base, plinth, and 6-inch- (150-mm-) long quarter-section Sample of shaft.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For fire-retardant-treated wood, from ICC-ES.

B. Sample Warranty: For manufacturer's warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

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

B. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
1.8 WARRANTY

A. Manufacturer's Warranty for Columns: Manufacturer agrees to repair or replace columns that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Columns: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

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

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

D. MDF: ANSI A208.2, Grade 130.

E. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

F. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

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

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC1 or UC2.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 18 percent, respectively.
2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
3. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
4. Do not use material that is warped or does not comply with requirements for untreated material.
5. Mark lumber with treatment-quality mark of an inspection agency approved by the American Lumber Standard Committee's Board of Review.
   a. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

6. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
   a. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.

7. Application: All interior lumber and plywood.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: For applications indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and comply with testing requirements; testing will be conducted by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
   1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.

C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not contain colorants, and provide materials that do not have marks from spacer sticks on exposed face.

D. Do not use material that does not comply with requirements for untreated material or is warped or discolored.

E. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
   1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
   2. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.

F. Application: All interior lumber and plywood.
2.4 INTERIOR TRIM

A. Softwood Lumber Trim for Transparent Finish (Stain or Clear Finish):
   1. Grade: Premium or 2 Common
   2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
   4. Face Surface: Surfaced (smooth).

B. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):
   1. Grade: Premium or 2 Common
   2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
   4. Face Surface: Surfaced (smooth).

C. Lumber Trim for Opaque Finish (Painted Finish):
   1. Grade: Eastern white pine, Premium or 2 Common
   2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
   4. Face Surface: Surfaced (smooth).
   5. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.

D. Softwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA WM 4, N-grade wood moldings. Made to patterns included in MMPA's "WM/Series Wood Moulding Patterns."
   1. Grade: Eastern white pine, Premium or 2 Common
   2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
   4. Face Surface: Surfaced (smooth).

E. Hardwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA HWM 4, N-grade wood moldings made to patterns included in MMPA's "HWM/Series Hardwood Moulding Patterns."
   1. Grade: Eastern white pine, Premium or 2 Common
   2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
   4. Face Surface: Surfaced (smooth).

F. Moldings for Opaque Finish (Painted Finish): Made to patterns included in MMPA's "WM/Series Wood Moulding Patterns."
2. Grade: Eastern white pine, Premium or 2 Common
3. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
5. Face Surface: Surfaced (smooth).
6. Hardwood Moldings: MMPA HWM 4, P-grade.
7. Optional Material: Primed MDF.

2.5 FIRE-RATED INTERIOR DOOR AND SIDELIGHT FRAMES
A. Manufacturers: Subject to compliance with requirements and as indicated on Drawings.
B. Frames, complete with casings, fabricated from fire-retardant particleboard or fire-retardant MDF with veneered exposed surfaces, or from solid fire-retardant-treated wood. Frames shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, based on testing according to NFPA 252.

2.6 MISCELLANEOUS MATERIALS
A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
B. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
C. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
D. Installation Adhesive for Foam Plastic Moldings: Product recommended for indicated use by foam plastic molding manufacturer.
E. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.
F. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.

2.7 FABRICATION
A. Back out or kerf backs of the following members, except those with ends exposed in finished work:
1. Interior standing and running trim, except shoe and crown molds.
2. Wood-board paneling.
B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

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

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.

B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.

2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.

4. Install stairs with no more than 3/16-inch (4.7-mm) variation between adjacent treads and risers and with no more than 3/8-inch (9.5-mm) variation between largest and smallest treads and risers within each flight.

5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.
3.4 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.

1. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
2. Install trim after gypsum-board joint finishing operations are completed.
3. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 ADJUSTING

A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes if any.

3.7 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023
SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Molded polystyrene foam-plastic board.
3. Polyisocyanurate foam-plastic board.
5. Glass-fiber board.
8. Loose-fill insulation.

B. Related Requirements:
1. Section 061600 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
2. Section 072119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
3. Section 075423 "Thermoplastic Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.
4. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.
1.5 DELIVERY, STORAGE, AND HANDLING

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

B. Protect foam-plastic board insulation as follows:

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

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

B. Extruded Polystyrene Board, Type X: ASTM C 578, Type X, 15-psi (104-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

C. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

D. Extruded Polystyrene Board, Type IV, Drainage Panels: ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

E. Extruded Polystyrene Board, Type VI: ASTM C 578, Type VI, 40-psi (276-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

F. Extruded Polystyrene Board, Type VI, Drainage Panels: ASTM C 578, Type VI, 40-psi (276-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84; fabricated with shiplap or channel edges and with one side having grooved drainage channels.
G. Extruded Polystyrene Board, Type VII: ASTM C 578, Type VII, 60-psi (414-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

H. Extruded Polystyrene Board, Type VII, Drainage Panels: ASTM C 578, Type VII, 60-psi (414-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

I. Extruded Polystyrene Board, Type V: ASTM C 578, Type V, 100-psi (690-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

2.2 MOLDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Molded Polystyrene Board, Type I: ASTM C 578, Type I, 10-psi (69-kPa) minimum compressive strength.

B. Molded Polystyrene Board, Type VIII: ASTM C 578, Type VIII, 13-psi (90-kPa) minimum compressive strength.

C. Molded Polystyrene Board, Type II: ASTM C 578, Type II, 15-psi (104-kPa) minimum compressive strength.

D. Molded Polystyrene Board, Type IX: ASTM C 578, Type IX, 25-psi (173-kPa) minimum compressive strength.

E. Molded Polystyrene Board, Type XIV: ASTM C 578, Type XIV, 40-psi (276-kPa) minimum compressive strength.

F. Molded Polystyrene Board, Type XV: ASTM C 578, Type XV, 60-psi (414-kPa) minimum compressive strength.

2.3 POLYISOCYANURATE FOAM-PLASTIC BOARD

A. Polyisocyanurate Board, Foil Faced: ASTM C 1289, foil faced, Type I, Class 1 or 2.

B. Polyisocyanurate Board, Glass-Fiber-Mat Faced: ASTM C 1289, glass-fiber-mat faced, Type II, Class 2.
2.4 GLASS-FIBER BLANKET

A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

B. Glass-Fiber Blanket, Polypropylene-Scrim-Kraft Faced: ASTM C 665, Type II (nonreflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).

C. Glass-Fiber Blanket, Kraft Faced: ASTM C 665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

D. Glass-Fiber Blanket, Reinforced-Foil Faced: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

E. Glass-Fiber Blanket, Foil Faced: ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

2.5 GLASS-FIBER BOARD

A. Glass-Fiber Board, Unfaced: ASTM C 612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84, passing ASTM E 136 for combustion characteristics. Nominal density of 2.25 lb/cu. ft (36 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

B. Glass-Fiber Board, Faced: ASTM C 612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84. Nominal density of 2.25 lb/cu. ft. (36 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

C. Glass-Fiber Board, Unfaced: ASTM C 612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84, passing ASTM E 136 for combustion characteristics. Nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

D. Glass-Fiber Board, Faced: ASTM C 612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84. Nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

E. Glass-Fiber Board, Unfaced: ASTM C 612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84, passing ASTM E 136 for combustion characteristics. Nominal density of 4.25 lb/cu. ft. (68 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).
F. Glass-Fiber Board, Faced: ASTM C 612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84. Nominal density of 4.25 lb/cu. ft. (68 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

G. Glass-Fiber Board, Unfaced: ASTM C 612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84, passing ASTM E 136 for combustion characteristics. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), thermal resistivity of 4.4 deg F x h x sq. ft./Btu x in. at 75 deg F (30.5 K x m/W at 24 deg C).

H. Glass-Fiber Board, Faced: ASTM C 612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), thermal resistivity of not less than 4.34 deg F x h x sq. ft./Btu x in. at 75 deg F (30.1 K x m/W at 24 deg C).

2.6 MINERAL-WOOL BLANKETS

A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

B. Mineral-Wool Blanket, Reinforced-Foil Faced: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

2.7 MINERAL-WOOL BOARD

A. Mineral-Wool Board, Types IA and IB, Unfaced: ASTM C 612, Types IA and IB; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of 4 lb/cu. ft. (64 kg/cu. m).

B. Mineral-Wool Board, Types IA and IB, Faced: ASTM C 612, Types IA and IB; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84. Nominal density of 4 lb/cu. ft. (64 kg/cu. m).

C. Mineral-Wool Board, Type II, Unfaced: ASTM C 612, Type II; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of 6 lb/cu. ft. (96 kg/cu. m).

D. Mineral-Wool Board, Type II, Faced: ASTM C 612, Type II; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84. Nominal density of 6 lb/cu. ft. (96 kg/cu. m).
E. Mineral-Wool Board, Type III, Unfaced: ASTM C 612, Type III; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of 8 lb/cu. ft. (128 kg/cu. m).

F. Mineral-Wool Board, Type III, Faced: ASTM C 612, Type III; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84. Nominal density of 8 lb/cu. ft. (128 kg/cu. m).

2.8 LOOSE-FILL INSULATION

A. Cellulosic-Fiber Loose-Fill Insulation: ASTM C 739, chemically treated for flame-resistance, processing, and handling characteristics.

B. Glass-Fiber Loose-Fill Insulation: ASTM C 764, Type I for pneumatic application or Type II for poured application; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

2.9 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
   1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
   2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
   1. Angle: Formed from 0.030-inch- (0.762-mm-) thick, perforated, galvanized carbon-steel sheet with each leg 2 inches (50 mm) square.
   2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
   1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
      a. Crawl spaces.
      b. Ceiling plenums.
      c. Attic spaces.

D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch (25 mm) between face of insulation and substrate to which anchor is attached.
E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.10 ACCESSORIES

A. Insulation for Miscellaneous Voids:
   1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
   2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

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

C. Asphalt Coating for Cellular-Glass Block Insulation: Cutback asphalt or asphalt emulsion of type recommended by manufacturer of cellular-glass block insulation.

D. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION, GENERAL

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

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

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

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

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) in from exterior walls.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

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

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

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

3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

B. Cellular-Glass Board Insulation: Install with closely fitting joints using adhesive pad attachment method according to manufacturer's written instructions.
3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
6. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:
   a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
   a. Exterior Walls: Set units with facing placed as indicated on Drawings.
   b. Interior Walls: Set units with facing placed as indicated on Drawings.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

C. Loose-Fill Insulation: Apply according to ASTM C 1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.

1. For cellulosic-fiber loose-fill insulation, comply with CIMA's Bulletin #2, "Standard Practice for Installing Cellulose Insulation."

D. Spray-Applied Cellulosic Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.
3.7 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
2. Install insulation to fit snugly without bowing.

3.8 INSTALLATION OF REFLECTIVE INSULATION

A. Install sheet reflective insulation according to ASTM C 727.
B. Install sheet radiant barriers according to ASTM C 1744.
C. Install interior radiation control coating system according to ASTM C 1321.

3.9 PROTECTION

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

END OF SECTION 072100
SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Building paper.
   2. Building wrap.
   3. Flexible flashing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

B. Shop Drawings: Show details of building paper and wrap at terminations, openings, and penetrations. Show details of flexible flashing applications.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

A. Building Paper: ASTM D 226, Type 1 (No. 15 asphalt-saturated organic felt), unperforated.

B. Building Paper: Water-vapor-permeable, asphalt-saturated kraft building paper that complies with ICC-ES AC38, Grade D; except with water-resistance rating not less than 1 hour.

C. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
1. Water-Vapor Permeance: Not less than 20 perms (1150 ng/Pa x s x sq. m) per ASTM E 96/E 96M, Desiccant Method (Procedure A).
2. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg (0.02 L/s x sq. m at 75 Pa) when tested according to ASTM E 2178.
3. Allowable UV Exposure Time: Not less than three months.
4. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

D. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 FLEXIBLE FLASHING

A. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
   1. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

B. Rubberized-Asphalt Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
   1. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

C. Primer for Flexible Flashing: Product recommended in writing by flexible flashing manufacturer for substrate.

D. Nails and Staples: Product recommended in writing by flexible flashing manufacturer and complying with ASTM F 1667.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.

B. Cover sheathing with water-resistive barrier as follows:
   1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
   2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap unless otherwise indicated.

C. Building Paper: Apply horizontally with a 2-inch (50-mm) overlap and a 6-inch (150-mm) end lap; fasten to sheathing with galvanized staples or roofing nails.
D. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.
   1. Seal seams, edges, fasteners, and penetrations with tape.
   2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
   1. Prime substrates as recommended by flashing manufacturer.
   2. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
   3. Lap flashing over water-resistive barrier at bottom and sides of openings.
   4. Lap water-resistive barrier over flashing at heads of openings.
   5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

3.3 DRAINAGE MATERIAL INSTALLATION

A. Install drainage material over building wrap and flashing to comply with manufacturer's written instructions.

END OF SECTION 072500
SECTION 072600 - VAPOR RETARDERS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Polyethylene vapor retarders.
      2. Reinforced-polyethylene vapor retarders.
      3. Fire-retardant, reinforced-polyethylene vapor retarders.
   B. Related Requirements:
      1. Section 033000 "Cast-in-Place Concrete" for under-slab vapor retarders.
      2. Section 072100 "Thermal Insulation" for vapor retarders integral with insulation products.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS
   A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS
   A. Polyethylene Vapor Retarders: ASTM D 4397, 6-mil- (0.15-mm-) thick sheet, with maximum permeance rating of 0.1 perm (5.7 ng/Pa x s x sq. m).

2.2 REINFORCED-POLYETHYLENE VAPOR RETARDERS
   A. Reinforced-Polyethylene Vapor Retarders: Sheet with outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and
weighing not less than 20 lb/1000 sq. ft. (9 kg/100 sq. m), with maximum permeance rating of 0.1 perm (5.7 ng/Pa x s x sq. m).

2.3 FIRE-RETARDANT, REINFORCED-POLYETHYLENE VAPOR RETARDERS

A. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: Sheet with outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nonwoven grid of nylon cord or polyester scrim and weighing not less than 20 lb/1000 sq. ft. (9 kg/100 sq. m), with maximum permeance rating of 0.1 perm (5.7 ng/Pa x s x sq. m).

1. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 200, respectively, per ASTM E 84.

2.4 ACCESSORIES

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

A. Place vapor retarders on side of construction indicated on Drawings.

B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 INSTALLATION OF VAPOR RETARDERS IN CRAWL SPACES

A. Install vapor retarders over prepared grade. Lap joints a minimum of 12 inches (305 mm) and seal with manufacturer's recommended tape. Install second layer over pathways to equipment.

B. Extend vapor retarder over footings and seal to foundation wall or grade beam with manufacturer's recommended tape.

1. Extend vapor retarder vertically minimum 24 inches (610 mm) above top of footing.

C. Seal around penetrations such as utilities and columns in order to create a monolithic, airtight membrane at grade surface, perimeter, and all vertical penetrations.

3.4 PROTECTION

A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 072600
SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes standing-seam metal roof panels.

B. Related Sections:

1. Section 074619 "Steel Siding"

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review structural loading limitations of deck during and after roofing.
6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:
   1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
   2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
   1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
   1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof area and eave, including fascia, and soffit as shown on Drawings; approximately 48 inches (1200 mm) 12 feet (3.5 m) square by full thickness, including attachments, underlayment, and accessories.
2. Build mockups for typical roof area only, including accessories.
   a. Size: 12 feet (3.5 m) long by 6 feet (1.75 m).
   b. Each type of exposed seam and seam termination.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including rupturing, cracking, or puncturing.
   b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for low slope roof products.

B. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:

1. Three-year, aged solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
2. Three-year, aged Solar Reflectance Index of not less than 64 when calculated according to ASTM E 1980.

C. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than indicated on the drawings.

D. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 1680 or ASTM E 283 at the following test-pressure difference:

E. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:
   1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).

F. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

G. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
   1. Uplift Rating: UL 60

H. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
   1. Fire/Windstorm Classification: Class 1A-60.
   2. Hail Resistance: MH

I. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
   1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
   2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.

B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for
sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.

1. MBCI, a Division of NCI Group or approved
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M
   a. Nominal Thickness: 0.028 inch (0.71 mm)
   b. Exterior Finish: Three-coat fluoropolymer
   c. Color: As selected by Architect from manufacturer's full range.
3. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
   a. Thickness: 0.032 inch (0.81 mm)
   b. Surface: Smooth, flat finish.
   c. Exterior Finish: Three-coat fluoropolymer
   d. Color: As selected by Architect from manufacturer's full range.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
   2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.

B. Felt Underlayment: ASTM D 226/D 22M, Type II (No. 30), asphalt-saturated organic felts.

C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch (25-mm)-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-(2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.

E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot-(3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

F. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch (1.2-mm) nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch-(1.52-mm-) nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

1. Insulate roof curb with 1-inch-(25-mm-) thick, rigid insulation.

G. Panel Fasteners: Self-tapping screws designed to withstand design loads.

H. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.


2.5 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements.
demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Concen fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

   a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:
1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

4. Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

5. FEVE Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

7. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

D. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Mica Fluoropolymer: AAMA 2605. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

4. Metallic Fluoropolymer: AAMA 2605. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

5. FEVE Fluoropolymer: AAMA 2605. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

7. Exposed Anodized Finish:
   a. Clear Anodic Finish: AAMA 611, or thicker.
   b. Color Anodic Finish: AAMA 611, or thicker.

E. Stainless-Steel Panels and Accessories:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   a. Run grain of directional finishes with long dimension of each piece.
   b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
   c. Directional Satin Finish: No. 4.

3. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

F. Copper Panels and Accessories:

1. Prepation: Factory prepatinate according to ASTM B 882 to convert the copper surface to an inorganic crystalline structure with the appearance and durability of naturally formed patina.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
   a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.
2. Apply over the roof area indicated on Drawings.

B. Felt Underlayment: Apply at locations indicated on Drawings, in shingle fashion to shed water, and with lapped joints of not less than 2 inches (50 mm).

1. Apply over the entire roof surface.
2. Apply on roof not covered by self-adhering sheet underlayment. Lap over edges of self-adhering sheet underlayment not less than 3 inches (75 mm), in shingle fashion to shed water.

C. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.4 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
3. Copper Panels: Use copper, stainless-steel, or hardware-bronze fasteners.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
5. Watertight Installation:

   a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
   b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
   c. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Clipless Metal Panel Installation: Fasten metal panels to supports with screw fasteners at each lapped joint at location and spacing recommended by manufacturer.

G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

I. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

J. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.

   1. Provide elbows at base of downspouts to direct water away from building.
   2. Connect downspouts to underground drainage system indicated.

K. Roof Curbs: Install flashing around bases where they meet metal roof panels.

L. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

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

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.
3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113.16
SECTION 074619 - STEEL SIDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes steel siding.

B. Related Requirements:

   1. Section 061000 "Rough Carpentry" for wood furring, grounds, nailers, and blocking.
   3. Section 072500 "Weather Barriers" for weather-resistant barriers.

1.3 COORDINATION

A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Initial Selection: For steel siding including related accessories.

C. Samples for Verification: For each type, color, texture, and pattern required.

   1. 12-inch- (300-mm-) long-by-actual-width Sample of siding.
   2. 24-inch- (600-mm-) wide-by-36-inch- (900-mm-) high Sample panel of siding assembled on plywood backing.
INFORMATIONAL SUBMITTALS

D. Product Certificates: For each type of steel siding.

E. Research/Evaluation Reports: For each type of steel siding required, from ICC-ES.

F. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Furnish full lengths of steel siding including related accessories, in a quantity equal to 2 percent of amount installed.

1.8 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
   1. Build mockup of typical wall area as shown on Drawings.
   2. Build mockups for siding including accessories.
      a. Size: 48 inches (1200 mm) long by 60 inches (1800 mm) high.
      b. Include outside corner on one end of mockup.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with labels intact until time of use.

B. Store materials on elevated platforms, under cover, and in a dry location.
1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including cracking and deforming.
   b. Hail damage, including denting.
   c. Deterioration of metals and other materials beyond normal weathering.
   d. Deterioration of metal finishes, including chalking and fading.

2. Fading is defined as loss of color, after cleaning with product recommended by manufacturer, of more than 5 Hunter color-difference units as measured according to ASTM D 2244.

3. Warranty Period: 25 years from date of Substantial Completion.

4. Warranty Period for Chalking and Fading: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.2 STEEL SIDING

A. Steel Siding: Formed product made from galvanized steel complying with ASTM A 653/A 653M, G90 (Z275) coating.

B. Horizontal Pattern: 8-inch (203-mm) exposure in plain, single-board style.

C. Horizontal Pattern: 10-inch (254-mm) exposure in plain, double, 5-inch (127-mm) board style.

D. Vertical Pattern: 12-inch (300-mm) exposure in board-and-batten, single board style.

E. Texture: Smooth.

F. Nominal Thickness: 0.017 inch (0.43 mm).

G. Finish: Manufacturer's standard primer and heat-fused PVC.

   1. Colors: As selected by Architect from manufacturer's full range of colors.

2.3 STEEL SOFFIT

A. Steel Soffit: Formed product made from galvanized steel complying with ASTM A 653/A 653M, G90 (Z275) coating.
B. Pattern: 12-inch (300-mm) exposure in board-and-batten, single-board style.

C. Texture: Smooth

D. Nominal Thickness: 0.017 inch (0.43 mm)

E. Finish: Manufacturer's standard primer and heat-fused PVC.
   1. Colors: As selected by Architect from manufacturer's full range of colors] [Match adjacent siding.

2.4 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
   1. Provide accessories made from same material adjacent siding unless otherwise indicated.

B. Flashing: Provide flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.

C. Fasteners:
   1. For fastening to wood, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch (25 mm) into substrate.
   2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch (6 mm), or three screw-threads, into substrate.
   3. For fastening galvanized steel, use hot-dip galvanized-steel fasteners. Where fasteners are exposed to view, use prefinished galvanized-steel fasteners in color to match item being fastened.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of steel siding and related accessories.

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

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.
3.3 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Center nails in elongated nailing slots without binding siding to allow for thermal movement.

B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

C. Where steel siding contacts dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.

3.4 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074619
SECTION 075423 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Adhered thermoplastic polyolefin (TPO) roofing system.
   2. Mechanically fastened thermoplastic polyolefin (TPO) roofing system.
   3. Loosely laid and ballasted thermoplastic polyolefin (TPO) roofing system.
   4. Vapor retarder.
   5. Roof insulation.

B. Section includes the installation of insulation strips in ribs of roof deck. Insulation strips are furnished under Section 053100 "Steel Decking."

C. Related Requirements:
   1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
   2. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
   3. Section 070150.19 "Preparation for Re-Roofing" for re-cover board beneath new roofing.
   4. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
   5. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
   7. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS
A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS
A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507t Zia Pueblo.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Zia Pueblo.

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

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:
   1. Sheet roofing, of color required.
   2. Aggregate surfacing material in gradation and color required.
   3. Roof paver, full sized, in each color and texture required.
   4. Walkway pads or rolls, of color required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
   1. Submit evidence of compliance with performance requirements.

C. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.

D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 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, approval or listing agency markings, 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.

1.10 FIELD 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.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, roof pavers, and other components of roofing system.

2. Warranty Period: 15 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers include the following:

1. Carlisle Syntec Inc.
2. Firestone Building Products
3. GAF Materials Corporation
4. GenFlex Roofing Systems
B. Source Limitations: Obtain components including roof insulation and fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.

1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures per Design Criteria:

D. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

E. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

F. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 TPO ROOFING


1. Thickness: 60 mils (1.5 mm), nominal.
2. Exposed Face Color: White.

2.4 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as TPO sheet.

C. Bonding Adhesive: Manufacturer's standard [water based].

D. Slip Sheet: Manufacturer's standard, of thickness required for application.

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1396/C 1396M, Type X gypsum board, 5/8 inch (16 mm) thick.

B. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, Type X, 5/8 inch (16 mm) thick.

C. Substrate Board: ASTM C 1278/C 1278M, cellulosic-fiber-reinforced, water-resistant gypsum substrate 1/2 inch (13 mm) thick.

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.6 VAPOR RETARDER

A. Polyethylene Film: ASTM D 4397, 6 mils (0.15 mm) thick, minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).

   1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
   2. Adhesive: Manufacturer's standard lap adhesive, FM Global approved for vapor-retarder application.

B. Laminated Sheet: Polyethylene laminate, two layers, reinforced with cord grid, with maximum permeance rating of 0.06 perm (3.5 ng/Pa x s x sq. m).
1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

C. Self-Adhering-Sheet Vapor Retarder: ASTM D 1970, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil- (1.0-mm-) total thickness; maximum permeance rating of 0.1 perm (6 ng/Pa x s x sq. m); cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

D. Self-Adhering-Sheet Vapor Retarder: Polyethylene film laminated to layer of butyl rubber adhesive, minimum 30-mil- (0.76-mm-) total thickness; maximum permeance rating of 0.1 perm (6 ng/Pa x s x sq. m); cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

E. Glass-Fiber Felts: ASTM D 2178, Type IV, asphalt impregnated.

2.7 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.

B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.6-lb/cu. ft. (26-kg/cu. m) minimum density, square edged.

C. Molded-Polystyrene Board Insulation: ASTM C 578, Type II, 1.35-lb/cu. ft. (22-kg/cu. m) minimum density.

D. Composite Molded-Polystyrene Board Insulation: ASTM C 578, Type II, 1.35-lb/cu. ft. (22-kg/cu. m) minimum density, with factory-applied facings, as follows:
   1. Facer: ASTM C 208, Type II, Grade 2, cellulosic-fiber insulation board, asphalt coated, 1/2 inch (13 mm) thick.
   2. Facer: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.

E. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 felt or glass-fiber mat facer on both major surfaces.

F. Composite Polyisocyanurate Board Insulation: ASTM C 1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.
   1. Type IV, cellulosic-fiber-insulating-board facer, Grade 2, 1/2 inch (13 mm) thick.
   2. Type V, oriented strand board facer, 7/16 inch (11 mm) thick.
   3. Type VII, glass-mat-faced gypsum board facer, 1/4 inch (6 mm) thick.

G. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 2, fibrous-felted, rigid insulation boards of wood fiber or other cellulosic-fiber and water-resistant binders, asphalt impregnated, chemically treated for deterioration.

H. Cellular-Glass Board Insulation: ASTM C 552, Type IV, rigid, cellular-glass thermal board insulation faced with manufacturer's standard kraft-paper sheets.
I. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.

J. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.8 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
   1. Modified asphaltic, asbestos-free, cold-applied adhesive.
   2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
   3. Full-spread spray-applied, low-rise, two-component urethane adhesive.

D. Cover Board: ASTM C 208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (13 mm) thick.

E. Cover Board: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.

F. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch (13 mm) thick, factory primed.

G. Cover Board: ASTM C 1278/C 1278M, cellulosic-fiber-reinforced, water-resistant gypsum substrate, 1/2 inch (13 mm) thick.

H. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.9 ASPHALT MATERIALS

A. Roofing Asphalt: ASTM D 312, Type III or Type IV.

B. Asphalt Primer: ASTM D 41/D 41M.

2.10 BALLAST

A. Aggregate Ballast: Smooth, washed, riverbed gravel or other acceptable smooth-faced stone that withstands weather exposure without significant deterioration and does not contribute to membrane degradation, of the following size:
1. Size: ASTM D 448, Size 4, ranging in size from 3/4 to 1-1/2 inches (19 to 38 mm).

B. Lightweight Roof Pavers: Interlocking, lightweight concrete units; grooved back, with four-way drainage capability; beveled, doweled, or otherwise profiled; and as follows:
   1. Compressive Strength: 2500 psi (17 MPa) minimum.
   2. Colors and Textures: As selected by Architect from manufacturer's full range.

2.11 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

B. Walkway Roof Pavers: Heavyweight, hydraulically pressed concrete units, with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C 140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C 67; and as follows:
   1. Size: 24 by 24 inches (600 by 600 mm). Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
   2. Weight: 18 lb/sq. ft. (90 kg/sq. m) Retain one of two options in "Compressive Strength" Subparagraph below.
   3. Compressive Strength: 6500 psi (45 MPa) minimum.
   4. Colors and Textures: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

   1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
   4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
   5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
   6. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION
A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
C. Install insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 ROOFING INSTALLATION, GENERAL
A. Install roofing system according to roofing system manufacturer's written instructions.
B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

3.4 SUBSTRATE BOARD INSTALLATION
A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
   1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 VAPOR-RETARDER INSTALLATION
A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively. Continuously seal side and end laps with tape or adhesive.
B. Laminate Sheet: Loosely lay laminate-sheet vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively. Continuously seal side and end laps with tape.
C. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches (90 mm) and 6 inches (150 mm), respectively. Seal laps by rolling.
D. Built-Up Vapor Retarder: Install two glass-fiber felt plies lapping each felt 19 inches (483 mm) over preceding felt. Embed each felt in a solid mopping of hot roofing asphalt. Glaze coat completed surface with hot roofing asphalt. Apply hot roofing asphalt within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
E. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation 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 insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.
2. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
4. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

H. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

I. Mechanically Fastened and Adhered Insulation: Install each layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.

2. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

3. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

4. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

J. Loosely Laid Insulation: Loosely lay insulation units over substrate.

K. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.

1. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

L. Install slip sheet over insulation and immediately beneath roofing.

3.7 ADHERED ROOFING INSTALLATION

A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.

E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.

F. Apply roofing with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.

2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.

3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.
3.8 MECHANICALLY FASTENED ROOFING INSTALLATION

A. Mechanically fasten roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

1. For in-splice attachment, install roofing with long dimension perpendicular to steel roof deck flutes.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Mechanically fasten or adhere roofing securely at terminations, penetrations, and perimeter of roofing.

E. Apply roofing with side laps shingled with slope of roof deck where possible.

F. In-Seam Attachment: Secure one edge of TPO sheet using fastening plates or metal battens centered within seam, and mechanically fasten TPO sheet to roof deck.

G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.9 LOOSELY LAID AND BALLASTED ROOFING INSTALLATION

A. Loosely lay roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing, without stretching, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Mechanically fasten or adhere perimeter of roofing according to requirements in SPRI RP-4.

E. Mechanically fasten or adhere roofing at corners, perimeters, and transitions according to requirements in SPRI RP-4.

1. At corners and perimeters, omit aggregate ballast leaving roofing exposed.
2. At corners and perimeters, adhere a second layer of roofing.
F. Apply roofing with side laps shingled with slope of deck where possible.

G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

I. Install protection mat over roofing, overlapping a minimum of 6 inches (150 mm). Install an additional protection mat layer at projections, pipes, vents, and drains, overlapping a minimum of 12 inches (300 mm).

J. Aggregate Ballast: Apply uniformly over roofing at the rate required by roofing system manufacturer, but not less than the following, spreading with care to minimize possibility of damage to roofing system. Lay ballast as roofing is installed, leaving roofing ballasted at the end of the workday.

K. Roof-Paver Ballast: Install lightweight roof-paver ballast according to manufacturer's written instructions.

L. Roof-Paver and Aggregate Ballast: Install heavyweight roof pavers according to manufacturer's written instructions on roof corners and perimeter.

1. Install Size 4 aggregate ballast elsewhere on roofing at a minimum rate of 10 lb/sq. ft. (50 kg/sq. m).
2. Install Size 2 aggregate ballast elsewhere on roofing at a minimum rate of 13 lb/sq. ft. (65 kg/sq. m).

3.10 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.
3.11 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer’s written instructions.

B. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer’s written instructions in locations indicated, to form walkways. Leave 3 inches (75 mm) of space between adjacent roof pavers.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

1. Electric Field Vector Mapping (EFVM): Testing agency shall survey entire roof area for potential leaks using electric field vector mapping (EFVM).

B. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (50 mm) of clearance from top of base flashing.
2. Flood each area for 24 hours.
3. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

C. Final Roof Inspection: Arrange for roofing system manufacturer’s technical personnel to inspect roofing installation on completion.

D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.13 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.14 ROOFING INSTALLER'S WARRANTY

A. WHEREAS ______________________________ of ___________________________, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <Insert name of Owner>.
2. Address: <Insert address>.
3. Building Name/Type: <Insert information>.
4. Address: <Insert address>.
5. Area of Work: <Insert information>.
6. Acceptance Date: _________________.
7. Warranty Period: <Insert time>.
8. Expiration Date: _________________.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period.

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
   a. lightning;
   b. peak gust wind speed exceeding Design Criteria
   c. fire;
   d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. vapor condensation on bottom of roofing; and
   g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.

3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this __________ day of __________________, ________________.

1. Authorized Signature: ____________________________________________.
2. Name: ________________________________________.
3. Title: ________________________________________.

END OF SECTION 075423
SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Manufactured through-wall flashing
      2. Manufactured reglets
      3. Formed roof-drainage sheet metal fabrications.
      5. Formed steep-slope roof sheet metal fabrications.
      6. Formed wall sheet metal fabrications.
      7. Formed equipment support flashing.
      8. Formed overhead-piping safety pans.

   B. Related Requirements:
      1. Section 061000 "Rough Carpentry" wood nailers, curbs, and blocking.
      2. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.3 COORDINATION
   A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

   B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507.
      1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
      2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
      3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.
   1. Include plans, elevations, sections, and attachment details.
   2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
   3. Include identification of material, thickness, weight, and finish for each item and location in Project.
   4. Include details for forming, including profiles, shapes, seams, and dimensions.
   5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   6. Include details of termination points and assemblies.
   7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
   8. Include details of roof-penetration flashing.
   9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
   10. Include details of special conditions.
   11. Include details of connections to adjoining work.
   12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish.
   1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
   2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
   3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
   4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 10 years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install roof edge flashings and coping tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth flat surface.

1. As-Milled Finish: Standard two-side bright
2. Alclad Finish: Metallurgically bonded surfacing alloy on both sides, forming aluminum sheet with reflective luster.
3. Factory Prime Coating: Where painting after installation is required, pretreat metal with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of 0.2 mil (0.005 mm).
4. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
5. Color Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
   a. Color: As selected by Architect from full range of industry colors and color densities.
b. Color Range: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

6. Exposed Coil-Coated Finish:
   a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   b. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   c. Mica Fluoropolymer: AAMA 2605. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   d. Metallic Fluoropolymer: AAMA 2605. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   e. FEVE Fluoropolymer: AAMA 2605. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   f. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

7. Color: As selected by Architect from manufacturer's full range.
8. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface.

   1. Finish: 2D (dull, cold rolled)

D. Zinc-Tin Alloy-Coated Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead-soft, fully annealed, stainless-steel sheet of minimum uncoated thickness indicated; coated on both sides with zinc-tin alloy (50 percent zinc, 50 percent tin), with factory-applied gray preweathering.

E. Zinc-Tin Alloy-Coated Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper, of minimum uncoated weight (thickness) indicated; coated on both sides with zinc-tin alloy (50 percent zinc, 50 percent tin).

F. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation or aluminum-zinc alloy-coated steel
sheet according to ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation, Grade 40 (Grade 275); prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. **Surface:** Smooth, flat and mill phosphatized for field painting and with manufacturer's standard clear acrylic coating on both sides.

2. **Exposed Coil-Coated Finish:**
   a. **Two-Coat Fluoropolymer:** AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   b. **Three-Coat Fluoropolymer:** AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   c. **Mica Fluoropolymer:** AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   d. **Metallic Fluoropolymer:** AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   e. **FEVE Fluoropolymer:** AAMA 621. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   f. **Siliconized Polyester:** Epoxy primer and silicone-modified, polyester-enamel topcoat; with dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

3. **Color:** As selected by Architect from manufacturer's full range.

4. **Concealed Finish:** Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

**G. Zinc Sheet:** 99.995 percent electrolytic high-grade zinc with alloy additives of copper (0.08 to 0.20 percent), titanium (0.07 to 0.12 percent), and aluminum (0.015 percent) Zinc, 99 percent pure, alloyed with 0.08 to 1.00 percent copper, 0.06 to 0.20 percent titanium, and up to 0.015 percent aluminum; with manufacturer's standard factory-applied, flexible, protective back coating.
   1. **Finish:** Preweathered gray.

**2.3 UNDERLAYMENT MATERIALS**

**A. Felt:** ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F (111 deg C); and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.

C. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
   1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
   2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
      b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
      c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
   2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
   3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
   4. Fasteners for Zinc-Tin Alloy-Coated Stainless-Steel Sheet: Series 300 stainless steel.
   5. Fasteners for Zinc-Coated (Galvanized) and Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
   6. Fasteners for Zinc Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Solder:
   1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
   2. For Zinc-Tin Alloy-Coated Stainless Steel: ASTM B 32, 100 percent tin, with maximum lead content of 0.2 percent, as recommended by sheet metal manufacturer.
3. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
4. For Zinc: ASTM B 32, 40 percent tin and 60 percent lead with low antimony, as recommended by zinc manufacturer.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane, polysulfide, or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.


2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Through-Wall, Ribbed, Sheet Metal Flashing: Manufacture through-wall sheet metal flashing for embedment in masonry, with ribs at 3-inch (75-mm) intervals along length of flashing to provide integral mortar bond. Manufacture through-wall flashing with snaplock receiver on exterior face to receive counterflashing or with interlocking counterflashing on exterior face, of same metal as flashing.
1. Stainless Steel: 0.016 inch (0.40 mm) thick.

B. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and counterflashing on exterior face, of same metal as reglet.
1. Material: Galvanized steel, 0.022 inch (0.56 mm) thick.
2. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
3. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
4. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
5. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
6. Accessories:
a. Flexible-Flash Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.

b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

7. Finish: Mill with manufacturer's standard color coating.

2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

2. Obtain field measurements for accurate fit before shop fabrication.

3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.

4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

2. Use lapped expansion joints only where indicated on Drawings.

E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
I. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

J. Do not use graphite pencils to mark metal surfaces.

2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Built-in Gutters: Fabricate to cross section required, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.

B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors Shop fabricate elbows.

C. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper. Fabricate from materials as shown on drawings.

D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from materials as shown on drawings.

E. Splash Pans: Fabricate to dimensions and shape required and Fabricate from materials as shown on drawings.

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing Gravel Stop and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Shop fabricate interior and exterior corners.

B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.

A. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from materials as shown on drawings.

B. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from materials as shown on drawings.

C. Flashing Receivers: Fabricate from materials as shown on drawings.

D. Roof-Penetration Flashing: Fabricate from materials as shown on drawings.

E. Roof-Drain Flashing: Fabricate from materials as shown on drawings.
F. STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

G. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:

H. Fabricate from materials as shown on drawings.

I. Fabricate from materials as shown on drawings.

J. Drip Edges Fabricate from materials as shown on drawings.

K. Counterflushing: Shop fabricate interior and exterior corners. Fabricate from materials as shown on drawings.

L. Flashing Receivers: Fabricate from materials as shown on drawings.

M. Roof-Penetration Flashing: Fabricate from materials as shown on drawings.

2.9 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Retain "Opening Flashings in Frame Construction" Paragraph below for nonmasonry-clad wood or cold-formed steel-framed walls. Claddings may include exterior insulation and finish systems (EIFS), siding, wood shingles, or shakes. Flashing is usually required to surround wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:

C. Wall Expansion-Joint Cover: Fabricate from materials as shown on drawings.

2.10 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from materials as shown on drawings.

B. Overhead-Piping Safety Pans: Fabricate from materials as shown on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

3.2 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

D. Apply slip sheet, wrinkle free before installing sheet metal flashing and trim.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by
painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.

2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws or substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel and aluminum sheet.

2. Do not pre-tin zinc-tin alloy-coated stainless steel and zinc-tin alloy-coated copper.

3. Do not use torches for soldering.

4. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

5. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer’s recommended methods for cleaning and neutralization.
3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.
   1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
   2. Provide elbows at base of downspout to direct water away from building.
   3. Connect downspouts to underground drainage system.

C. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in asphalt roofing cement or elastomeric sealant compatible with the substrate.

D. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
   1. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
   2. Loosely lock front edge of scupper with conductor head.
   3. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

E. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch (25 mm) below scupper or gutter discharge.

F. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 inches (100 mm) in direction of water flow.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend
counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm). Secure in waterproofing.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

3.7 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.8 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.9 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean
finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200
SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Copings.
   2. Roof-edge specialties.
   3. Roof-edge drainage systems.
   4. Reglets and counterflashings.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for downspout guards and downspout boots.
   2. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
   3. Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
   4. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
   5. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

C. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507.
   1. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
   2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
   3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
B. Shop Drawings: For roof specialties.
   1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
   2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
   3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
   4. Detail termination points and assemblies, including fixed points.
   5. Include details of special conditions.

C. Samples: For each type of roof specialty and for each color and texture specified.

D. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

E. Samples for Verification:
   1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
   2. Include roof-edge specialties, reglets and counterflashings made from 12-inch (300-mm) lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of roof specialty.

C. Product Test Reports: For roof-edge flashings, for tests performed by a qualified testing agency.

D. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are SPRI ES-1 tested to specified design pressure.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.

1. Build mockup of typical roof edge as shown on Drawings.
2. Build mockup of typical roof edge as part of Integrated Exterior Mockup specified in Section 014000 "Quality Requirements"
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING
   A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
   B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.8 FIELD CONDITIONS
   A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.
   B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY
   A. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
      1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
         a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
         b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
         c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
      2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
   B. SPRI Wind Design Standard: Manufacture and install roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:
1. Design Pressure: As indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 ROOF-EDGE SPECIALTIES

A. Canted Roof-Edge Fascia and Gravel Stop: Manufactured, two-piece, roof-edge fascia consisting of snap-on or compression-clamped metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous formed galvanized-steel sheet cant, 0.028 inch (0.71 mm) thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.

B. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous metal receiver with integral drip-edge cleat to engage fascia cover and secure single-ply roof membrane. Retain "One-Piece Gravel Stops" Paragraph below for a one-piece gravel stop; revise to suit Project. Product configurations vary considerably; revise to suit Project.

C. One-Piece Gravel Stops: Manufactured, one-piece, metal gravel stop in section lengths not exceeding 12 feet (3.6 m), with a horizontal flange and vertical leg, drain-through fascia terminating in a drip edge, and concealed splice plates of same material, finish, and shape as gravel stop.

2.3 REGLETS AND COUNTERFLASHINGS

A. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from exposed metal as shown on drawings.

B. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped. Material as shown on drawings.

C. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.

2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
2.4 MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

D. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

E. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 or H01 temper.

2.5 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

B. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum.

2.6 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
   1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
   2. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
   3. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
   4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
   5. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.

B. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.


2.7 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Coil-Coated Galvanized-Steel Sheet Finishes:
   1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A 755/A 755M and coating and resin manufacturers' written instructions.
      a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      b. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      c. Two-Coat Mica Fluoropolymer: AAMA 621. Fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers’ written instructions.
      d. Three-Coat Metallic Fluoropolymer: AAMA 621. Fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      e. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

E. Coil-Coated Aluminum Sheet Finishes:
   1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply
coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

b. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

c. Two-Coat Mica Fluoropolymer: AAMA 2605. Fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

d. Three-Coat Metallic Fluoropolymer: AAMA 2605. Fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

e. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

F. Aluminum Extrusion Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer: AAMA 2604. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

b. Three-Coat Fluoropolymer: AAMA 2604. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

c. Two-Coat Mica Fluoropolymer: AAMA 2604. Fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

d. Three-Coat Metallic Fluoropolymer: AAMA 2604. Fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

e. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

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

3.2 UNDERLAYERMNT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under roof-edge specialties and reglets and counterflashings.
2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

3.3 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.
Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum and stainless-steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.


1. Space movement joints at a maximum of 12 feet (3.6 m) no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws or substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

ROOF-EDGE SPECIALITIES INSTALLATION

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
B. Parapet Scuppers: Install scuppers through parapet where indicated. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and seal or solder to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. Seal or solder exterior wall scupper flanges into back of conductor head.

C. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch (25 mm) below scupper discharge.

3.6 REGLET AND COUNTERFLASHING INSTALLATION

A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.

C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077100
SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Roof curbs.
2. Equipment supports.
3. Roof hatches.
4. Hatch-type heat and smoke vents.
5. Dropout-type heat and smoke vents.
7. Pipe and duct supports.
8. Pipe portals.
10. Roof walkways.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
2. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
3. Section 077100 "Roof Specialties" for manufactured fasciae, copings, gravel stops, gutters and downspouts, and counterflashing.
4. Section 086200 "Unit Skylights" for single- and double-glazed domed plastic skylights with curb frame.

1.3 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
1.4 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.
   1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

D. Delegated-Design Submittal: For roof curbs, equipment supports, and walkways indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
   2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
   1. Size and location of roof accessories specified in this Section.
   2. Method of attaching roof accessories to roof or building structure.
   3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
   4. Required clearances.

B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design roof curbs and equipment supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind-Restraint Performance: As indicated on Drawings.

2.2 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, and integrally formed deck-mounting flange at perimeter bottom.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

A. Supported Load Capacity: As indicated on Drawings.

B. Material: As indicated on Drawings.

C. Construction:

   1. Curb Profile: Manufacturer's standard compatible with roofing system.
   2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
   3. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
   4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.
5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
6. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick glass-fiber board insulation.
7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
8. Nailer: Factory-installed wood nailer along top flange of curb under top flange on side of curb, continuous around curb perimeter.
9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weather tight platform cap formed from 3/4-inch (19-mm) thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
11. Metal Counter flashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.
12. Damper Tray: Provide damper tray or shelf with opening 3 inches (76 mm) less than interior curb dimensions indicated.

2.3 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced perimeter or Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements and integrally formedstructure-mounting flange at bottom.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Supported Load Capacity: As per the Design Criteria.

D. Material: As per the Drawings.
1. Color: As selected by Architect from manufacturer's full range.

E. Construction:
1. Curb Profile: Manufacturer's standard Profile as indicated on Drawings compatible with roofing system.
2. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick glass-fiber board insulation.
3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
4. Nailer: Factory-installed continuous wood nailers 3-1/2 inches (90 mm) wide continuous around support perimeter.
5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch (19-mm) thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.

7. Metal Counterflushing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.

8. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.

9. Fabricate equipment supports to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.

2.4 HEAT AND SMOKE VENTS

A. Hatch-Type Heat and Smoke Vents: Manufacturer's standard, with double-walled insulated curbs, welded or mechanically fastened and sealed corner joints, integral condensation gutter, and cap flashing. Fabricate with insulated double-walled lid and continuous weathertight perimeter lid gaskets, and equip with automatic self-lifting mechanisms and UL-listed fusible links rated at 165 deg F (74 deg C).

2.5 PIPE AND DUCT SUPPORTS

A. Fixed-Height Cradle-Type Pipe Supports: Polycarbonate pipe stand accommodating up to 1-1/2-inch (38-mm-) diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

B. Fixed-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand with polycarbonate or stainless-steel roller carrying assembly accommodating up to 7-inch (178-mm-) diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

C. Adjustable-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand base, pipe support, and roller housing, with stainless-steel threaded rod designed for adjusting support height, accommodating up to 18 inch (457 mm) diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

D. Adjustable-Height Structure-Mounted Pipe Supports: Extruded-aluminum tube, filled with urethane insulation; 2 inches (50 mm) in diameter; accommodating up to 7-inch (178-mm-) diameter pipe or conduit, with provision for pipe retainer; with aluminum baseplate, EPDM base seal, manufacturer's recommended hardware for mounting to structure or structural roof deck as indicated, stainless-steel roller and retainer, and extruded-aluminum carrier assemblies; as required for quantity of pipe runs and sizes.

E. Curb-Mounted Pipe Supports: Galvanized steel support with welded or mechanically fastened and sealed corner joints and integrally formed deck-mounting flange at perimeter bottom; with adjustable-height roller-bearing pipe support accommodating up to 20-inch (508-mm-) diameter pipe or conduit and with provision for pipe retainer; as required for quantity of pipe runs and sizes.
F. Duct Supports: Extruded-aluminum, urethane-insulated supports, 2 inches (50 mm) in diameter; with manufacturer's recommended hardware for mounting to structure or structural roof deck.
   1. Finish: Manufacturer's standard.

2.6 PIPE PORTALS
   A. Curb-Mounted Pipe Portal: Insulated roof-curb units with welded or mechanically fastened and sealed corner joints and integrally formed deck-mounting flange at perimeter bottom; with weathertight curb cover with single or multiple collared openings and pressure-sealed conically shaped EPDM protective rubber caps sized for piping indicated, with stainless-steel snaplock swivel clamps.
   B. Flashing Pipe Portal: Formed aluminum membrane-mounting flashing flange and sleeve with collared opening and pressure-sealed conically shaped EPDM protective rubber cap sized for piping indicated, with stainless-steel snaplock swivel clamps.

2.7 PREFORMED FLASHING SLEEVES
   A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches (300 mm) high, with removable metal hood and metal collar.
   B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.

2.8 ROOF WALKWAYS
   A. Roof Walkway: Metal planking formed from multiple C-shaped channels with upper surface punched in serrated diamond or rectangular shapes to produce raised slip-resistant surface and drainage holes. Provide support framing, brackets, connectors, nosings, and other accessories and components needed for complete installation.
      1. Include step units or stairs of similar construction for changes in elevation. Comply with ASCE-7, 29 CFR 1910.23, and requirements of authorities having jurisdiction.
      2. Equip walkways with safety railings where required.

2.9 METAL MATERIALS
   A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation and mill phosphatized for field painting where indicated.
      1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
      2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).
      3. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

4. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 (AZM150) coated.

1. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).

2. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

3. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).

C. Aluminum Sheet: ASTM B 209 (ASTM B 209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Mill Finish: As manufactured.

2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).

3. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

4. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).
D. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

E. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.

F. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

G. Steel Tube: ASTM A 500/A 500M, round tube.

H. Galvanized-Steel Tube: ASTM A 500/A 500M, round tube, hot-dip galvanized according to ASTM A 123/A 123M.


2.10 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Acrylic Glazing: ASTM D 4802, thermoformable, monolithic sheet, manufacturer's standard, Type UVA (formulated with UV absorber), Finish 1 (smooth or polished).

C. Polycarbonate Glazing: Thermoformable, monolithic polycarbonate sheets manufactured by extrusion process, burglar-resistance rated according to UL 972 with an average impact strength of 12 to 16 ft-lbf/in. (640 to 854 J/m) of width when tested according to ASTM D 256, Method A (Izod).

D. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, thickness as indicated.

E. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C), thickness as indicated.

F. Polyisocyanurate Board Insulation: ASTM C 1289, thickness and thermal resistivity as indicated.

G. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

I. Underlayment:
   1. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
   2. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.
   3. Slip Sheet: Building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum, rosin sized.
4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

5. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

6. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.

7. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

8. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

J. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

K. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane and silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

L. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.


2.11 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.
   1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
   2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
   3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
   4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of uncoated aluminum and stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.

C. Roof Curb Installation: Install each roof curb so top surface is level.

D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

E. Roof-Hatch Installation:
   1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
   2. Attach safety railing system to roof-hatch curb.
   3. Attach ladder-assist post according to manufacturer's written instructions.

F. Heat and Smoke Vent Installation:
   1. Install heat and smoke vent so top perimeter surfaces are level.
   2. Install and test heat and smoke vents and their components for proper operation according to NFPA 204.

G. Gravity Ventilator Installation: Verify that gravity ventilators operate properly and have unrestricted airflow. Clean, lubricate, and adjust operating mechanisms.

H. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.
1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

I. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

J. Security Grilles: Weld bar intersections and, using tamper-resistant bolts, attach the ends of bars to structural frame or primary curb walls.

K. Roof Walkway Installation:
   1. Verify that locations of access and servicing points for roof-mounted equipment are served by locations of roof walkways.
   2. Remove ballast from top surface of low-slope roofing at locations of contact with roof-walkway supports.
   3. Install roof walkway support pads prior to placement of roof walkway support stands onto low-slope roofing.
   4. Redistribute removed ballast after installation of support pads.

L. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200
SECTION 07900

JOINT SEALERS

PART 1 - GENERAL

1.01 DESCRIPTION

Work includes, but is not necessarily limited to, all sealants and joint treatment necessary to provide a positive barrier against passage of moisture and air, at locations required and as described below. Contractor shall furnish all supplementary items necessary for proper installation using manufacturer's components.

1.02 SUBMITTALS

A. Product Data

Provide complete materials list, including catalogue data, of all materials, equipment and products for work in this section.

B. Certifications

As a condition of acceptance, submit certification stating that sealants and joint treatments are installed per submittal and are complete and ready for intended function.

1.03 COORDINATION

Work in this section requires close coordination with work in other sections, sequence all work to assure an orderly progress in the project, without removal of previously installed work and so as to prevent damage to finishes and products.

1.04 PRODUCT HANDLING

A. Protection

Use all means necessary to protect work in this section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements

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

C. Product Storage

Do not retain on site any material which has exceeded the shelf life recommended by the manufacturer.

1.05 WARRANTY

Provide a warranty against material or workmanship failure for a period of two years.

PART 2 - PRODUCTS
2.01 SEALANTS
A. General
1. Unless noted otherwise, all sealants shall be the products of the designated manufacturers. Subject to compliance with requirements, comparable products may be used based on Owner's review of submittals per Section 01300 "Submittals."
2. All sealants for each application shall be the product of a single manufacturer, suitable for the intended use.

B. Product Characteristics

Location: Sealant

1. Exterior Sealant
   - ASTM C920 Vulkem 116
   - Grade NS
   - Tremco Dymonic
   - Sonneborn NPI

2. Horizontal Sealant
   - ASTM C920 Vulkem 245
   - Grade P or NS
   - Tremco THC-900/901
   - Sonneborn SL-2

3. Interior Caulk
   - ASTM C834 Pecora AC20
   - Tremco Acrylic Latex 834
   - Sonneborn Sonolac

4. Acoustical Sealant
   - Non Rated - Non Hardening
   - Tremco "Acoustical Sealant Lowery's" 10A Acoustical Sealer

5. Acoustical Sealant
   - Fire Rated
   - Dow Fire Stop Sealant

6. Silicone Sealant
   - Sanitary
   - GE SCS 1702
   - Dow 786

7. Silicone Sealant
   - Structural
   - GE SCS 1200
   - Dow 795
   - Tremco Spectrem 2

C. For other applications provide products especially formulated for the proposed.

D. Colors:
   1. Colors for each sealant installation will be selected by the Owner from full color line normally available from the specified manufacturer.
   2. Should such standard color not be available from the approved manufacturer except at additional charge, provide such colors at no additional cost to the Owner.

2.02 RATED ASSEMBLY PENETRATION SEALANTS AND FOAMS
A. Manufacturer
   1. Design is based on products manufactured by:
      - DOW Corning Corporation
      - Midland, Michigan 48686-0994
B. Product Characteristics: Fire Stop Sealant
   1. Product: Dow Corning Fire Stop Sealant
   2. Material: One part, ready to use material with the consistency of a soft caulk.
   3. Classified: By Underwriter's Laboratory, Inc.

D. Product Characteristics: Fire Stop Foam
   1. Product: Dow Corning Fire Stop Foam.
   3. Classified: By Underwriter's Laboratory, Inc.

2.03 PRE-COMPRressed JOINT FILLER
A. Manufacturer
   1. Design is based on products manufactured by:
      EMSEAL Joint Systems Ltd.
      48 Union Street 203-967-3828
      Stamford CT 06906 1-800-872-3677
   2. Subject to compliance with requirements, comparable products may be used based on Architect's
      review of submittals per Section 01630 "Product Options and Substitutions."

B. Product Characteristics
   1. Product: Emseal Greyflex Expanding Foam
   2. Material: High density open cell polyurethene foam with stabilized acrylics. Precompressed in
      shrink wrapped lengths or in tape form with adhesive backing on reels.
   3. Size: Compression to 25% of joint dimension.

2.04 PRIMERS
   Use only those primers which have been tested for durability on the surfaces to be sealed and are specifi-
   cally recommended for this installation by the manufacturer of the sealant used.

2.05 BACKUP MATERIALS
   Use only those backup materials which are specifically recommended for this installation by the manufa-
   cturer of the sealant used, which are non-absorbent and which are non-staining.

2.06 BOND BREAKER
   Bond breaker, if required, shall be as recommended by the sealant manufacturer.

2.07 MASKING TAPE
   For masking around joints, provide an appropriate masking tape which will effectively prevent application
   of sealant on surfaces not scheduled to receive it, and which is removable without damage to sub-
   strate.

2.08 SOLVENTS
   Solvents or cleaning agents shall be as recommended by the sealant manufacturer and the adjacent sur-
   face/finish manufacturers.

2.09 OTHER MATERIALS
   Provide other materials, not specifically described but required for a complete and proper installation, as
   selected by the Contractor subject to the approval of the Architect.
PART 3 - EXECUTION

3.01 SURFACE CONDITIONS
Examine the areas and conditions under which the work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION
A. Concrete and Masonry Surfaces:
   1. Install only on surfaces which are dry, sound and well brushed, wiping free from dust.
   2. At open joints, remove dust by mechanically blown compressed air if so required.
   3. To remove oil and grease, use sandblasting or wire brushing.
   4. Where surfaces have been treated, remove the surface treatment by sandblasting or wire brushing.
   5. Remove laitance and mortar from joint cavities.

B. Steel Surfaces:
   1. Unprimed or unfinished steel surfaces in contact with sealant:
      a. Sandblast as required to achieve acceptable surface for bond.
      b. If sandblasting is not practical, or would damage adjacent finish, scrape the metal or wire brush to remove mill scale and rust.
      c. Use solvent to remove oil and grease, wiping the surfaces with clean white rags only.
   2. Remove protective coatings on steel by sandblasting or by using a solvent which leaves no residue.

3.03 INSTALLATION OF BACKUP MATERIAL
When using backup of tube or rod stock, avoid lengthwise stretching of the material. Do not twist or braid hose or rod backup stock. Install in clean dry joint at the proper depth to provide manufacturer's recommended sealant dimensions.

3.04 PRIMING
Use only the primer approved by the architect for the particular installation, applying in strict accordance with the Manufacturer's recommendations as approved by the Architect.

3.05 BOND-BREAKER INSTALLATION
Provide an approved bond-breaker where recommended by the Manufacturer of the sealant and where directed by the Architect, adhering strictly to the Manufacturers' installation recommendations.

3.06 INSTALLATION OF SEALANTS
A. Prior to start of installation in each joint, verify the joint type according to details on the drawings or as otherwise directed by the architect and verify that the required proportion of width of joint to depth of joint has been secured.

B. Equipment:
   1. Apply sealant under pressure with power-actuated hand gun or manually-operated hand gun or by other appropriate means.
   2. Use guns with nozzle of proper size and providing sufficient pressure to completely fill the joints as designed.

C. Thoroughly and completely mask joints where the appearance of primer or sealant on adjacent surfaces would be objectionable.

D. Install the sealant in strict accordance with the manufacturer's recommendations, thoroughly filling joints to the recommended depth.
E. Tool joints to the profile shown on the Drawings or as otherwise recommended by the manufacturer if such profiles are not shown on the Drawings.

F. Methods: Fire Stop Sealant and Foam
   1. Install in strict accordance with U.L. listed system/assembly.
   2. All gaps or cracks left after damming material are in place shall be sealed.
   3. Immediately after mixing, dispense liquid foam into the penetration opening.
   4. Allow for foam expansion.
   5. When dispensing continuously, do not exceed measured snap time or a maximum of three minutes, whichever is less.
   6. If opening is not filled when shot reaches measured swap time or the three minute maximum, stop application to allow foam to set for at least 15 minutes.
   7. Repeat injection and cure procedure until the opening is filled.
   8. Leave dam in place for 24 hour to allow foam to fully cure.
   9. Inspect cured penetration seal after 24 hours by removing damming material.
  10. Cured foam should completely fill penetration. Fill all gaps with freshly mixed fire stop foam or fire stop sealant.
  11. Reinspect again after 24 hours.
  12. Damming materials required to achieve a fire rating must be returned to the penetration.

G. Cleaning up:
   1. Remove masking tape immediately after joints have been tooled.
   2. Clean adjacent surfaces free from sealant as the installation progresses, using solvent or cleaning agent recommended by the manufacturer of the sealant used.
   3. Upon completion of the work of this Section, promptly remove from the job site all debris, containers, and surplus material derived from this portion of the Work.

END OF SECTION 07900
PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes hollow-metal work.
B. Related Requirements:
   1. Section 081119 "Stainless-Steel Doors and Frames" for hollow-metal doors and frames manufactured from stainless steel.
   2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS
A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION
A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507.

1.6 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
B. Shop Drawings: Include the following:
1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduits and preparations for power, signal, and control systems.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification:
   1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 127 mm).
   2. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately 12 by 12 inches (305 by 305 mm) to demonstrate compliance with requirements for quality of materials and construction:
      a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
      b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

E. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
   1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Standard-Duty Doors and Frames: SDI A250.8, Level 1. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level C according to SDI A250.4.
2. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm).
   c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.032 inch (0.8 mm).
   d. Edge Construction: Full Flush.
   e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
   f. Core: Kraft-paper honeycomb Polystyrene, Polyurethane, or Polyisocyanurate Mineral board.
3. Frames:
   a. Materials: Uncoated cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
   b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
   c. Construction: Knocked down or Slip-on drywall.


C. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.
   1. Physical Performance: Level B according to SDI A250.4.
   2. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches (44.5 mm).
      c. Face: Uncoated cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
      d. Edge Construction: Full Flush.
      e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
      f. Core: Kraft-paper honeycomb Polystyrene, Polyurethane, or Polyisocyanurate Mineral board.

3. Frames:
   a. Materials: Uncoated cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
   b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
   c. Construction: Knocked down or Slip-on drywall.


D. Hollow-Metal Doors and Frames: NAAMM-HMMA 860. At locations indicated in the Door and Frame Schedule.
   1. Physical Performance: Level A according to SDI A250.4.
   2. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches (44.5 mm).
      c. Face: Uncoated cold-rolled steel sheet, minimum thickness of 0.032 inch (0.8 mm).
      d. Edge Construction: Continuously welded with no visible seam.
      e. Core: Steel stiffened.

3. Frames:
a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm) for frames that receive hollow-metal doors; minimum thickness of 0.042 inch (1.0 mm) for frames that receive hollow-core wood doors.

b. Materials: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm)

Frames: Fabricated from same thickness material as adjacent door frame.

c. Construction: Knocked down or Slip-on drywall.


2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level B according to SDI A250.4.

2. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm).
   c. Face: Uncoated cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
   d. Edge Construction: Full Flush.
   e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
   f. Core: Kraft-paper honeycomb Polystyrene, Polyurethane, or Polyisocyanurate Mineral board.

   1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.

3. Frames:

   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
   b. Construction: Knocked down or Face welded.


5. Frames:

   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
   b. Construction: Knocked down or Face welded.

C. Hollow-Metal Doors and Frames: NAAMM-HMMA 860. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm.)
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum G60 ((Z180) or)A60 (ZF180) coating.
   d. Edge Construction: Continuously welded with no visible seam.
   e. Core: Steel stiffened.

   1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.

3. Frames:
   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum G60 ((Z180) or)A60 (ZF180) coating.
   b. Construction: Knocked down or Face welded.


D. Commercial Doors and Frames: NAAMM-HMMA 861. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm.)
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.30 mm), with minimum G60 ((Z180) or)A60 (ZF180) coating.
   d. Edge Construction: Continuously welded with no visible seam.
   e. Core: Steel stiffened.

   1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.

3. Frames:
   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7 mm), with minimum G60 ((Z180) or)A60 (ZF180) coating.
   b. Construction: Face welded.

2.5 HOLLOW-METAL PANELS

A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-(9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.7 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Section 088000 "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.8 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.

2. Fire Door Cores: As required to provide fire-protection ratings indicated.


4. Top Edge Closures: Close top edges of doors with closures, except provide flush closures at exterior doors of same material as face sheets.

5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.

6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.

4. Jamb Anchors: Provide number and spacing of anchors as follows:

2.9 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with SDI A250.3.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.10 ACCESSORIES

A. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer’s written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-Homba 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   a. At fire-rated openings, install frames according to NFPA 80.
   b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   c. Install frames with removable stops located on secure side of opening.
   d. Install door silencers in frames before grouting.
   e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
   a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.


4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:
   a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).

c. At Bottom of Door: 3/4 inch (19.1 mm)

d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113
PART 1 - GENERAL

1.1 RELATED WORK DESCRIBED ELSEWHERE

A. Unit Masonry: Section 04200
B. Gypsum Drywall: Section 09250
C. Acoustical Ceilings: Section 09510
D. Painting: Section 09900

1.2 DESCRIPTION OF WORK

Extent, location and size of each type of access door as required.

1.3 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Wherever a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge and latch from manufacturer listed in UL “Classified Building Materials Index” for rating that is shown. Provide UL label on each fire-rated access door.
B. Size Variations: Obtain Architect’s acceptance of manufacturer’s standard size units, which may vary slightly from the sizes indicated.
C. Manufacturer: Provide access doors by one of the following:
   - Birmingham Ornamental Iron Company
   - Karp Associates, Inc.
   - Milcor Division; Inryco, Inc.
   - Nystrom, Inc.
   - The Perlite Company
D. Coordination: Furnish inserts and anchoring devices, which must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s technical data & installation instructions for each type of access door assembly, including setting drawings, templates, instructions and directions for installation of anchorage devices.
B. Shop Drawings: Submit shop drawings for fabrication and installation of customized access doors & frames, including details of each frame type, elevations of door design types, anchorage and accessory items.
PART 2 - PRODUCTS

2.1 MATERIALS AND FABRICATION

A. General: Furnish each access door assembly manufactured as an integral unit, complete with all parts and ready for installation.

B. Steel Access Doors and Frames: Fabricate units of continuous welded steel construction, unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to type of support shown.

C. Frames: Fabricate from 16 gage steel.
   1. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.
   2. For plaster applications, furnish frames with expanded metal lath and exposed casing bead, welded to perimeter of frame.

D. Flush Panel Doors: Fabricate from not less than 14 gage steel sheet, with concealed spring hinges or concealed continuous piano hinge set to open 175°. Finish with manufacturer’s factory-applied prime paint.
   1. Provide flush panel doors, unless otherwise indicated.
   2. For fire-rated units, provide manufacturer’s standard insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

E. Recessed Panel Doors: Fabricate from not less than 18 gage sheet steel with face of panel formed to provide recess below surface of applied finish. Reinforce panel as required to prevent buckling. Finish with manufacturer’s factory-applied prime paint. Furnish recessed panels for concealed installation in acoustic tile ceiling systems.

F. Locking Devices: Furnish flush, screwdriver-operated cam locks of number required to hold door in flush, smooth plane when closed.
   1. Provide one cylinder lock per access door. Furnish two keys per lock and key all locks alike unless otherwise scheduled.
   2. Where shown or scheduled, provide one cylinder lock per access door. Furnish two keys per lock and key all locks alike, unless otherwise scheduled.

PART 3 - EXECUTION

3.1 INSPECTION

Installer must examine areas and conditions under which access doors are to be installed and must notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with the work until unsatisfactory conditions have been corrected in manner acceptable to the installer.

3.2 INSTALLATION

A. Comply with manufacturer’s instructions for installation of access doors.
B. Coordinate installation with work of other trades. Building in of anchors and grouting of frames is included in Division 4 of these specifications.

C. Set frames accurately in position and securely attach to the supports with face panels plumb of level in relation to adjacent finish surface.

3.3 ADJUST AND CLEAN

A. Adjust hardware and panels after installation for proper operation.

B. Remove and replace panels or frames which are warped, bowed or otherwise damaged.

END OF SECTION 08305
SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes aluminum windows for exterior locations.

B. Related Requirements:
   1. Section 084113 "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507.
   1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
   3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
   4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
   5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.

B. Shop Drawings: For aluminum windows.
1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.

D. Samples for Initial Selection: For units with factory-applied finishes.
   1. Include Samples of hardware and accessories involving color selection.

E. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:
   1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).
   2. Exposed Hardware: Full-size units.

F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For manufacturer's warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.

B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Build mockup of typical wall area as shown on Drawings.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure to meet performance requirements.
   b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
   c. Faulty operation of movable sash and hardware.
   d. Deterioration of materials and finishes beyond normal weathering.
   e. Failure of insulating glass.

2. Warranty Period:
   a. Window: 10 years from date of Substantial Completion.
   b. Glazing Units: Five years from date of Substantial Completion.
   c. Aluminum Finish: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: AAMA certified with label attached to each window.


C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40.

E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.

F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change: 120 deg F (67 deg C) ambient; 180 deg F (100 deg C) material surfaces.

G. Sound Transmission Class (STC): Rated for not less than 30 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

2.3 ALUMINUM WINDOWS

A. Acceptable manufacturers include the following:
1. Kawneer North America
2. Thermal Windows Inc.
3. Architect accepted substitution

B. Operating Types: Provide operating types in locations indicated on Drawings:

C. Frames and Sashes: Aluminum extrusions complying with AAMA/ WDMA/ CSA 101/L.S.2/A440.

1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

D. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3.


E. Windborne-Debris-Impact-Resistant Laminated Glass: ASTM C 1172 with two plies of float glass.

F. Insulating-Glass Units: ASTM E 2190.

1. Glass: ASTM C 1036, Type 1, Class 1, q3.
   a. Tint: Clear.
2. Filling: Fill space between glass lites with air.
3. Low-E Coating: Pyrolytic on second surface.

G. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

1. Dual Glazing System:
   a. Interior Lite: Glass
   b. Exterior Lite: Insulating-glass unit.

H. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.

I. Projected Window Hardware:

1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.
   a. Type and Style: As selected by Architect from manufacturer's full range of types and styles.

2. Hinges: Non-friction type, not less than two per sash.

3. Lock: Key-operated custodial lock with keeper and removable handle.

4. Limit Devices: Concealed friction adjustor, adjustable stay bar limit devices designed to restrict sash opening.
   a. Limit clear opening to 4 inches (100 mm) for ventilation; with custodial key release.

5. Pole Operators: Tubular-shaped anodized aluminum; with rubber-capped lower end and standard push-pull hook at top to match hardware design; of sufficient length to operate window without reaching more than 60 inches (1500 mm) above floor; one pole operator and pole hanger per room that has operable windows more than 72 inches (1800 mm) above floor.

J. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

K. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

A. Integral Ventilating System/Device: Where indicated, provide weather-stripped, adjustable, horizontal fresh-air vent, with a free airflow slot, full width of window sash by approximately 1 inch (25 mm) when open, complying with AAMA/WDMA/CSA 101/I.S.2/A440. Equip vent bar with an integral insect screen, removable for cleaning.

B. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.

C. Column Covers: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

D. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

E. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
F. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.5 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.

B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.

C. Aluminum Wire Fabric: 18-by-16 (1.1-by-1.3-mm) mesh of 0.011-inch- (0.28-mm-) diameter, coated aluminum wire.

2.6 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.

F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

D. Class II, Color Anodic Finish: AA-M12C22A32/A34 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker) complying with AAMA 611.

E. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

F. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

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

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
2. Air-Infiltration Testing:
   a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/LS.2/A440 performance class indicated.
   b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/LS.2/A440 rate for product type and performance class rounded down to one decimal place.

3. Water-Resistance Testing:
   a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/LS.2/A440 performance grade indicated.
   b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.

5. Test Reports: Prepared according to AAMA 502.

C. Windows will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.
3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
   1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113
SECTION 086200 - UNIT SKYLIGHTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Self-flashing unit skylights with integral curbs.
2. Unit skylights mounted on prefabricated curbs.

B. Related Requirements:
1. Section 086300 "Metal-Framed Skylights" for site-erected, metal-framed skylights.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Zia Pueblo.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of unit skylight.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for unit skylights.
2. Motors: Show nameplate data, power requirements, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: For unit skylight work.

1. Include plans, elevations, sections, details, and connections to supporting structure and other adjoining work.

a. Wiring Diagrams: For power, signal, and control wiring for electric motors of operable unit skylights.
4. Multiple Units: Methods of connection and structural support for multiple units clustered together.

C. Aluminum Finish Samples: For each type of exposed finish required, in a representative section of each unit skylight in manufacturer's standard size.

D. Glazing Samples: For each color and finish of glazing indicated, 12 inches (300 mm) square and of same thickness indicated for the final Work.

E. Product Schedule: For unit skylights. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type and size of unit skylight, for tests performed within the last four years by a qualified testing agency. Test results based on testing of smaller unit skylights than specified will not be accepted.

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For unit skylights to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating unit skylights that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

B. Installer Qualifications: An installer acceptable to unit skylight manufacturer for installation of units required for this Project.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of unit skylights that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Uncontrolled water leakage.
   b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   c. Yellowing of acrylic glazing.
   d. Breakage of polycarbonate glazing.
2. Deterioration of insulating-glass hermetic seal.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers include the following:
   1. Solatube
   2. Architect approved substitution

2.2 PERFORMANCE REQUIREMENTS

A. Unit Skylight Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

B. Thermal Transmittance: NFRC 100 maximum U-factor of 0.50 Btu/sq. ft. x h x deg F (2.83 W/sq. m x K) or less.

C. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum SHGC of 0.40.

D. Outside-Inside Transmission Class (OITC): Rated for not less than 26 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

2.3 UNIT SKYLIGHTS

A. General: Provide factory-assembled unit skylights that include glazing, extruded-aluminum glazing retainers, gaskets, and inner frames and that are capable of withstanding performance requirements indicated.

B. Unit Shape and Size: As indicated on drawings.

C. Acrylic Glazing: ASTM D 4802, thermoformable, monolithic sheet, category as standard with manufacturer, Finish 1 (smooth or polished), Type UVF (formulated with UV absorber).

D. Polycarbonate Glazing: Thermoformable, extruded monolithic sheets, UV resistant, burglar-resistance rated according to UL 972, and with average impact strength of 12 to 16 ft-lb/in. (640 to 854 J/m) of width when tested according to ASTM D 256, Test Method A (Izod).
   1. Self-Ignition Temperature: 650 deg F (343 deg C) or more for plastic sheets in thickness indicated when tested according to ASTM D 1929.
   2. Smoke-Production Characteristics: Smoke-developed index of 450 or less when tested according to ASTM E 84, and smoke density of 75 or less when tested according to
E. Polycarbonate-Insulating-Panel Glazing: Manufacturer's standard polycarbonate sheet with cellular cross section that provides isolated airspaces and that is coextruded with a UV-protective layer.

F. Fiberglass-Sandwich-Panel Glazing: Manufacturer's standard with uniformly colored, translucent, fiberglass-reinforced-polymer face sheets permanently adhered to a grid core.

G. Glazing Gaskets: Manufacturer's standard

H. Integral Curb: Extruded-aluminum self-flashing type.
   1. Extruded-Aluminum Shapes: ASTM B 221 (ASTM B 221M), alloy and temper to suit structural and finish requirements but with not less than the strength and durability of Alloy 6063-T52.
   2. Height: As indicated
   3. Construction: Double wall.
   4. Insulation: Manufacturer's standard rigid or semirigid type.

I. Prefabricated Curb: As specified in Section 077200 "Roof Accessories."

J. Condensation Control: Fabricate unit skylights with integral internal gutters and nonclogging weeps to collect and drain condensation to the exterior.

K. Thermal Break: Fabricate unit skylights with thermal barrier separating exterior and interior metal framing.

L. Protective Screens: Manufacturer's standard to protect against windborne debris and hail.

2.4 ACCESSORY MATERIALS

A. Fasteners: Same metal as metal being fastened, nonmagnetic stainless steel, or other noncorrosive metal as recommended by manufacturer. Finish exposed fasteners to match material being fastened.
   1. Where removal of exterior exposed fasteners might allow access to building, provide nonremovable fastener heads.

B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat.

2.5 ALUMINUM FINISHES

A. Mill Finish: Manufacturer's standard.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
   1. Color: As selected by Architect from full range of industry colors and color densities.
2. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Coordinate installation of unit skylight with installation of substrates, vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight.

B. Comply with recommendations in AAMA 1607 and with manufacturer's written instructions for installing unit skylights.

C. Install unit skylights level, plumb, and true to line, without distortion.

D. Anchor unit skylights securely to supporting substrates.

E. Where aluminum surfaces of unit skylights will contact another metal or corrosive substrates, such as preservative-treated wood, apply bituminous coating on concealed metal surfaces or provide other approved permanent separation recommended in writing by unit skylight manufacturer.

3.3 FIELD QUALITY CONTROL

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

B. After completion of installation and nominal curing of sealant and glazing compounds but before installation of interior finishes, test for water leaks according to AAMA 501.2.

C. Perform test for total area of each unit skylight.

D. Work will be considered defective if it does not pass tests and inspections.
E. Additional testing and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.4 CLEANING

A. Clean exposed unit skylight surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes.

B. Remove excess sealants, glazing materials, dirt, and other substances.

C. Remove and replace glazing that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect unit skylight surfaces from contact with contaminating substances resulting from construction operations.

E. Unit Skylight Operating System: Clean and lubricate joints and hardware. Adjust for proper operation.

END OF SECTION 086200
SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Mechanical door hardware for the following:
         a. Swinging doors.
      2. Cylinders for door hardware specified in other Sections.
      3. Electrified door hardware.
   B. Related Requirements:
      1. Section 064113 "Wood-Veneer-Faced Architectural Cabinets" for cabinet door hardware provided with cabinets.
      2. Section 081113 "Hollow Metal Doors and Frames" Section 081213 "Hollow Metal Frames"
      3. Section 083323 "Overhead Coiling Doors" for door hardware provided as part of overhead coiling door assemblies.

1.3 ALLOWANCES
   A. Door hardware is part of [Door Hardware Allowance].

1.4 COORDINATION
   A. Floor-Recessed Door Hardware: Coordinate layout and installation with floor construction.
      1. Cast anchoring inserts into concrete.
   B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
   C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.

B. Keying Conference: Conduct conference at Zia Pueblo.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.
2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:
   a. Flow of traffic and degree of security required.
   b. Preliminary key system schematic diagram.
   c. Requirements for key control system.
   d. Requirements for access control.
   e. Address for delivery of keys.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

C. Samples: For each exposed product in each finish specified, in manufacturer's standard size.

1. Tag Samples with full product description to coordinate Samples with door hardware schedule.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For each type of exposed product, in each finish specified.
1. Sample Size: Full-size units or minimum 2-by-4-inch (51-by-102-mm) Samples for sheet and 4-inch (102-mm) long Samples for other products.
   a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

2. Tag Samples with full product description to coordinate Samples with door hardware schedule.

F. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule after or concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:
   a. Identification number, location, hand, fire rating, size, and material of each door and frame.
   b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
   c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
   d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
   e. Fastenings and other installation information.
   f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
   g. Mounting locations for door hardware.
   h. List of related door devices specified in other Sections for each door and frame.

G. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and Architectural Hardware Consultant.

B. Product Certificates: For each type of electrified door hardware.

1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware and keying schedule.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Door Hardware: one additional full set of each hardware set.
   2. Electrical Parts: one additional electrical component of each.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

   1. Warehousing Facilities: In Project's vicinity.
   2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
   3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC), Architectural Hardware Consultant (AHC) and an Electrified Hardware Consultant (EHC), or Architectural Openings Consultant (AOC).

1.11 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including excessive deflection, cracking, or breakage.
   b. Faulty operation of doors and door hardware.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

   a. Electromagnetic and Delayed-Egress Locks: Five years from date of Substantial Completion.
   b. Exit Devices: Two Insert number years from date of Substantial Completion.
   c. Manual Closers: 10 years from date of Substantial Completion.
   d. Concealed Floor Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of door hardware from single manufacturer.

   1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the ABA standards of the Federal agency having jurisdiction.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
2. Comply with the following maximum opening-force requirements:
   a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
   b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
   c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.

1. Door hardware is scheduled on Drawings.

2.4 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

2.5 SELF-CLOSING HINGES AND PIVOTS

A. Self-Closing Hinges and Pivots: BHMA A156.17.
2.6 CENTER-HUNG AND OFFSET PIVOTS

A. Center-Hung and Offset Pivots: BHMA A156.4.

2.7 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Pin-and-Barrel-Type Hinges:

C. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

2.8 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
3. Deadbolts: Minimum 1.25-inch (32-mm) bolt throw.

C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.

D. Lock Trim:

1. Description: As indicated on Drawings
2. Levers: As indicated on Drawings
3. Escutcheons (Roses): As indicated on Drawings
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Bored Locks: BHMA A156.2; Grade 2; Series 4000.
G. Mortise Locks: BHMA A156.13; Security Grade 1 stamped steel case with steel or brass parts; Series 1000.

H. Interconnected Locks: BHMA A156.12; Grade 2; Series 5000.

I. Roller Latches: BHMA A156.16; Grade 1; rolling plunger that engages socket or catch, with adjustable roller projection.

J. Push-Pull Latches: Mortise, BHMA A156.13; with paddle handles that retract latchbolt; capable of being mounted vertically or horizontally.
   1. Grade: 2.

2.9 AUXILIARY LOCKS

A. Bored Auxiliary Locks: BHMA A156.36: Grade 2; with strike that suits frame.

B. Mortise Auxiliary Locks: BHMA A156.36; Grade 2; with strike that suits frame.

C. Narrow Stile Auxiliary Locks: BHMA A156.36; Grade 2; with strike that suits frame.

D. Push-Button Combination Locks: BHMA A156.36; cylindrical; Grade 1; lock opens by entering a one- to five-digit code by pushing correct buttons in correct sequence; automatically relocks when door is closed; with strike that suits frame.

2.10 ELECTRIC STRIKES

A. Electric Strikes: BHMA A156.31; Grade 2; with faceplate to suit lock and frame.

2.11 ELECTROMAGNETIC LOCKS

A. Electromagnetic Locks: BHMA A156.23; electrically powered; with electromagnet attached to frame and armature plate attached to door; full-exterior or full-interior type, as required by application indicated.

B. Delayed-Egress Electromagnetic Locks: BHMA A156.24, electrically powered, with electromagnet attached to frame and armature plate attached to door; depressing push bar for more than three seconds initiates irreversible alarm and adjustable time delay for egress. When integrated with fire alarm, fire alarm voids time delay.

2.12 ELECTROMECHANICAL LOCKS

A. Electromechanical Locks: BHMA A156.25; Grade 2; motor or solenoid driven; with strike that suits frame.
   1. Type: Mortise deadlocking latchbolt.
2.13 SELF-CONTAINED ELECTRONIC LOCKS

A. Self-Contained Electronic Locks: BHMA A156.25, mortise; with internal, battery-powered, self-contained electronic locks; consisting of complete lockset, motor-driven lock mechanism, and actuating device; enclosed in zinc-dichromate-plated, wrought-steel case, and strike that suits frame. Provide key override, low-battery detection and warning, LED status indicators, and ability to program at the lock.

2.14 EXIT LOCKS AND EXIT ALARMS

A. Exit Locks and Alarms: BHMA A156.29, Grade 1.

2.15 SURFACE BOLTS

A. Surface Bolts: BHMA A156.16.

2.16 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.

2.17 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge. Include wear plates.

2.18 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

2.19 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

B. Standard Lock Cylinders: BHMA A156.5; Grade 2 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable.

C. High-Security Lock Cylinders: BHMA A156.30; Grade 2 permanent cores that are removable; face finished to match lockset.

1. Type: M, mechanical
D. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

E. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.20 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

1. No Master Key System: Only change keys operate cylinders.
   a. Provide three cylinder change keys.

2. Master Key System: Change keys and a master key operate cylinders.
   a. Provide three cylinder change keys and five master keys.

3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
   a. Provide three cylinder change keys and five each of master and grand master keys.

4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.
   a. Provide three cylinder change keys and five each of master, grand master, and great-grand master keys.

5. Existing System:
   a. Master key or grand master key locks to Owner's existing system.
   b. Re-key Owner's existing master key system into new keying system.

6. Keyed Alike: Key all cylinders to same change key.

B. Keys: Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
   a. Notation: "DO NOT DUPLICATE."

2.21 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 50.
1. Multiple-Drawer Cabinet: Grade 2 cabinet with drawers equipped with key-holding panels and key envelope storage, and progressive-type ball-bearing suspension slides. Include single cylinder lock to lock all drawers.

2. Wall-Mounted Cabinet: Grade 2 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.

3. Portable Cabinet: Grade 2 tray for mounting in file cabinet, equipped with key-holding panels, envelopes, and cross-index system.

B. Key Lock Boxes: Designed for storage of 10 keys.

C. Key Control System Software: Multiple-index system for recording and reporting key-holder listings, tracking keys and lock and key history, and printing receipts for transactions. Include instruction manual.

2.22 OPERATING TRIM

A. Operating Trim: BHMA A156.6; aluminum unless otherwise indicated.

2.23 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.

B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

C. Astragals: BHMA A156.22.

2.24 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

2.25 CONCEALED CLOSERS

A. Concealed Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
2.26 CLOSER HOLDER RELEASE DEVICES
   A. Closer Holder Release Devices: BHMA A156.15; Grade 1; closer connected with separate or integral releasing and fire- or smoke-detecting devices. Door shall become self-closing on interruption of signal to release device. Automatic release is activated by smoke detection system.

2.27 MECHANICAL STOPS AND HOLDERS
   A. Wall- and Floor-Mounted Stops: BHMA A156.16.

2.28 ELECTROMAGNETIC STOPS AND HOLDERS
   A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; wall-mounted electromagnetic single unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire-alarm system for labeled fire-rated door assemblies.

2.29 OVERHEAD STOPS AND HOLDERS
   A. Overhead Stops and Holders: BHMA A156.8.

2.30 DOOR GASKETING
   A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
   B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:
      1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
      2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
      3. Gasketing on Double Doors: 0.50 cfm per foot (0.000774 cu. m/s per m) of door opening.

2.31 THRESHOLDS
   A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.32 SLIDING DOOR HARDWARE
   A. Sliding Door Hardware: BHMA A156.14; consisting of complete sets including rails, hangers, supports, bumpers, floor guides, and accessories indicated.
2.33 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick aluminum; with manufacturer's standard machine or self-tapping screw fasteners.

2.34 PLASTIC PROTECTION PLATES

A. Plastic Protection Plates: BHMA A156.6; fabricated with four sides beveled; plastic laminate; 1/8 inch (3.2 mm) thick; NEMA LD 3, Grade HGS.

2.35 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

2.36 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Auxiliary Electrified Door Hardware:

2.37 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2. Fire-Rated Applications:

a. Wood or Machine Screws: For the following:

1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
2) Strike plates to frames.
3) Closers to doors and frames.

b. Steel Through Bolts: For the following unless door blocking is provided:
   1) Surface hinges to doors.
   2) Closers to doors and frames.
   3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.38 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with door and hardware manufacturers' written instructions.
3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated on Drawings to comply with the following unless otherwise indicated or required to comply with governing regulations.

2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying schedule and/or directed by Owner.
2. Furnish permanent cores to Owner for installation.

F. Key Control System:

1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
2. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.
3. Key Control System Software: Set up multiple-index system based on final keying schedule.

G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room. Verify location with Architect.
1. Configuration: Provide one power supply for each door opening with electrified door hardware.

H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

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

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.

3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.
B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

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

B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.8 DEMONSTRATION

A. Engage Installer to train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.9 DOOR HARDWARE SCHEDULE

END OF SECTION 087100
GLASS AND GLAZING

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE
   A. Rough Carpentry: Section 06100
   B. Finish Carpentry: Section 06200
   C. Steel Doors and Frames: Section 08100
   D. Wood Doors: Section 08200
   E. Entrances and Storefronts: Section 08400

1.02 DESCRIPTION OF WORK
   Glass includes prime glass, processed glass and fabricated glass products. Glazing includes glass installation and materials used to install glass. Types of work in this section include glass and glazing for skylights, window units, entrances, and other doors.

1.03 QUALITY ASSURANCE
   A. Prime Glass Standards: FS DD-G-451
   B. Heat-Treated Glass Standard: FS DD-G-1403
   C. Safety Glass Standard: CPSC 16 CFR 1201
   D. Glazing manual of the Flat Glass Manufacturer’s Association (FNMA)
   E. PPG Industries “Technical Services Report No. 104”.
   F. ANSI Z97.1 for safety glazing.
   G. Sealed Insulating Glass Manufacturer’s Association (SIGMA) No. 65-7-2.
   H. Insulating glass to comply with HUD UM 82a Sealed insulating Glass.
   I. General Electric “Silicone Sealant Design” Guide No. 1, 2, 3, 4, & 5
   J. Glass and glazing materials shall not fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability. Glass and glazing materials shall not appear to deteriorate in any other manner not clearly specified by submitted manufacturers’ data as an inherent quality of the material for the exposure indicated.

1.04 JOB CONDITIONS
   Coordinate glazier and other trades affected by glass installation prior to beginning of installation. Do not perform work under adverse weather or job conditions. Install liquid sealants when temperatures are within lower or middle third of temperature range recommended by the manufacturer.

1.05 SUBMITTALS
   A. Samples: One sample 12” square of each glass product.
   B. Shop Drawings: Submit five (5) set of distinct prints of shop drawings.
1.06 PRODUCT WARRANTY

A. Warranty on Hermetic Seals:
   1. Provide insulating glass manufacturer’s written warranty agreeing to, within specified warranty period, furnish FOB project site, replacement units for insulating glass units which have defective hermetic seals (excluding that due to glass breakage); defined to include intrusion of moisture or dirt, internal condensation at temperatures above -20°F (-31°C), deterioration of internal glass coatings, and other visual evidence of seal failure or performance failure; provided the manufacturer’s instructions for handling, installation, protection and maintenance have been adhered to during warranty period.
   2. Warranty period is ten years after seal date permanently imprinted on unit, but not less than nine years after date of substantial completion.

B. All other warranties and guarantees shall apply for a period of five (5) years unless otherwise indicated.

PART 2 - PRODUCTS

2.01 GLASS PRODUCTS

A. Float/Plate Glass: Type I, Quality Q3, clear unless otherwise indicated, thickness as noted, Class 2, Quality Q3 for tinted.

B. Polished Wire Glass: Type III, Quality Q11.

C. Mirror: ¼” inch thick ASTM C1036, Type I, class 1, Quality q1 Mirror Select. Glass shall have electrolytically copper plated back; mirrors shall have edges ground and polished (mirrors to be frameless).

2.02 PROCESSED GLASS

A. Tempered Glass: Provide prime glass of color and type indicated which has been heat treated to strengthen glass in bending to not less than 4.5 times annealed strength. Provide tempered glass produced by manufacturer’s special process which eliminates tong marks.

B. Heat-Strengthened Glass: Provide prime glass of color and type indicated which has been heat-treated to strengthen bending to not less than 2 times annealed strength.

2.03 FABRICATED GLASS UNITS

A. Insulating Glass: Provide two sheets of glass as follows, and 1” dry air or gas-filled space with -20°F (-29°C) dew point, with Class A sealant-type edge construction to maintain a hermetic seal; fabricated to provide the following overall performance characteristics:
   1. Exterior Glass: 1” insulated glass - ¼” Azuria, ½” air space, ¼” clear float, shading coefficient of .44; tempered where required by code.
   2. Interior Glass: Clear laminated, Quality Q3, 1/4” thick.
   3. Edge Construction: Twin primary seals of polyisobutylene; tubular aluminum or galvanized steel spacer-bar frame with welded or soldered sealed corners, and filled with desiccant; and secondary seal the outside of bar, bonded to both sheets of glass and bar of polysulfide, silicone or hot-melt butyl elastomeric sealant (fabricator’s option).
   4. Warranty: Provide manufacturer’s standard ten year product warranty on maintained hermetic seal.

B. Polished Wire Glass: 1/4” Mississippi Baroque polished on both sides. Square pattern.

2.04 GLAZING SEALANTS AND COMPONENTS

A. Provide color of exposed sealant/compound indicated or if not otherwise indicated, as selected by Architect from the manufacturer’s standard colors, or black if no color is so selected. Comply with manufacturer’s recommendations for selections of hardness, depending upon location of each application, condi-
tions at time of installation, and performance requirements as indicated. Select materials and variations or modifications carefully for compatibility with surfaces contacted in installation.

B. Two-Part Polysulfide Glazing Sealants: Elastomeric polysulfide sealant complying with FS TT-S-227, Class A, Type 2; specially compounded and tested to show a minimum of twenty years resistance to deterioration in normal glazing applications.

C. One-Part Silicone Rubber Glazing Sealant: Elastomeric silicone sealant complying with FS TT-S-00230, Class A, Type II, compounded specifically for exterior exposed glazing.

D. Preformed Butyl Rubber Glazing Sealant: Compound of polymerized butyl rubber and inert fillers with or without polyisobutylene modification; solvent-based, 95% solids, formed and coiled on release paper; tack-free in 24 hours, paintable, non-staining, plain, preshimmed or reinforced as required for proper installation and setting of glass.

2.05 GLAZING GASKETS
A. Molded Neoprene Glazing Gaskets: Molded or extruded neoprene gaskets of profile and hardness required for watertight construction; comply with ASTM D 2000 designation 28C 415 or 38C 620, black.

B. Cellular Neoprene Glazing Gaskets: Extruded/molded, closed-cell, integral-skinned neoprene of profile required to maintain watertight seal; comply with ASTM C 509, Type II, black.

C. Vinyl Foam Glazing Tape: Closed cell, flexible, self-adhesive, non-extruding, polyvinyl chloride foam tape; recommended by manufacturer for exterior, exposed, watertight installation of glass, with only nominal pressure in glazing channel; comply with ASTM D 1667.

2.06 MISCELLANEOUS GLAZING MATERIALS
A. Cleaners, Primers, Sealers: Type recommended by sealant or gasket manufacturer.

B. Setting Blocks: Neoprene or EPDM, 70-90 durometer hardness with proven compatibility with sealants used.

C. Spacers: Neoprene or EPDM, 40-50 durometer hardness with proven compatibility with sealants used.

D. Compressible Filler (Rod): Closed cell or waterproof jacketed rod stack of synthetic rubber or plastic foam proven to be compatible with sealants used, flexible and resilient, with 5-10 psi compression strength for 25% deflection.

PART 3 - EXECUTION

3.01 STANDARDS AND PERFORMANCE
A. Watertight and airtight installation of each glass product is required, except as other-wise shown. Each installation must withstand normal temperature changes, wind loading, impact loading (for operating sash and doors), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.

B. Protect glass from edge damage during handling and installation and subsequent operation of glazed components of the work. During installation, discard units with significant edge damage or other imperfections.

C. Glazing channel dimensions as shown are intended to provide for necessary bite on glass, minimum edge clearance, and adequate sealant thickness, with reasonable tolerances. Adjust as required by job conditions at time of installation.
D. Comply with combined recommendations and technical reports by manufacturers of glass and glazing products as used in each glazing channel, and with recommendations of Flat Glass Marketing Association “Glazing Manual,” except where more stringent requirements are indicated.

E. Install insulating glass units to comply with recommendations by Sealed Insulating Glass Manufacturers Association, except as otherwise specifically indicated or recommended by the glass and sealant manufacturers.

3.02 PREPARATION FOR GLAZING

A. Clean glazed channel and other framing members to receive glass immediately before glazing. Remove coatings which are not firmly bonded to substrate. Remove lacquer from metal surfaces where elastomeric sealants are used.

B. Apply primer or sealant to joint surfaces where recommended by the sealant manufacturer.

3.03 GLAZING

A. Install setting blocks of proper size in sill rabbet, located 1/4 of glass width from each corner. Set blocks in thin course of heel-bead compound, if any.

B. Provide spacers, inside and out, of proper size and spacing for glass sizes larger than 50 united inches, except where gaskets at preshimmed tapes are used for glazing. Provide 1/8” minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

C. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.

D. Voids and Filler Rods: Prevent exudation of sealant or compound by forming voids or installing filler rods in channel at heel of jambs and head (do not leave voids in sill channels), except as otherwise indicated and depending on light size, thickness, and type of glass, and complying with the manufacturer’s recommendations.

E. Force sealants into channel to eliminate voids and to ensure complete “wetting” or bond of sealant to glass and channel surfaces.

F. Tool exposed surfaces of glazing liquids and compounds to provide a substantial “wash” away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel so as to eliminate dirt and moisture pockets.

G. Clean and trim excess glazing materials from glass and stops or frames promptly after installation and eliminate stains and discoloration.

H. Where wedge-shaped gaskets are driven into one side of the channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not “walk” out when installation is subjected to movement. Anchor gasket to stop with matching ribs, or by proven adhesives, including embedment of gasket tail in cured heel bead.

I. Gasket Glazing: Miter cut and bond ends together at corners where gaskets are used for channel glazing so that gaskets will not pull away from corners and result in voids or leaks in glazing system.

3.04 SECURE, PROTECTION, CLEANING

A. Protect exterior glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove non-permanent labels and clean the surfaces. Cure the sealants for high early strength and durability.

B. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents, and vandalism.
C. Wash and polish glass on both faces not more than four days prior to date scheduled for inspections intended to establish date of substantial completion in each area of the project. Comply with glass product manufacturer’s recommendations for the final cleaning.

END OF SECTION 08800
SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Studs and Runners: Provide documentation that framing members' certification is according to SIFA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For embossed steel studs and runners and firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft. (239 Pa).

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.


B. Studs and Runners: ASTM C 645.

1. Steel Studs and Runners:
   a. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection.
   b. Depth: As indicated on Drawings.

2. Embossed Steel Studs and Runners:
   a. Minimum Base-Metal Thickness: As required by horizontal deflection performance requirements.
   b. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to runners while allowing 1-1/2-inch (38-mm) minimum vertical movement.

2. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.

3. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

4. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
   1. Depth: As indicated on Drawings.
   2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

   1. Minimum Base-Metal Thickness: As indicated on Drawings.
   2. Depth: As indicated on Drawings.

H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
   1. Configuration: Asymmetrical or hat shaped.

I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
   1. Depth: As indicated on Drawings
   2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
   3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:
   1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
   2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Flat Hangers: Steel sheet, in size indicated on Drawings.
E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings.

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Runners: ASTM C 645.
   a. Minimum Base-Metal Thickness: As indicated on Drawings
   b. Depth: As indicated on Drawings.
3. Embossed Steel Studs and Runners: ASTM C 645.
   a. Minimum Base-Metal Thickness: As indicated on Drawings
   b. Depth: As indicated on Drawings.
4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
   a. Minimum Base-Metal Thickness: As indicated on Drawings
5. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
   a. Configuration: Asymmetrical or hat shaped.

G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.

2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.

2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.

3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.

4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
3. Tile Backing Panels: As required by horizontal deflection performance requirements unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
   a. Install two studs at each jamb unless otherwise indicated.
   b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
   c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

6. Curved Partitions:
   a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
   b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches (1219 mm) o.c.
2. Carrying Channels (Main Runners): [48 inches (1219 mm) o.c.
3. Furring Channels (Furring Members): [24 inches (610 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
   
a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.

4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Do not attach hangers to steel roof deck.

6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.

7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.

8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216
CSI SECTION 09 24 00 – PORTLAND CEMENT PLASTER

PART 1 - GENERAL

1.1  SECTION INCLUDES
A. Supply and Installation of El Rey FastWall® 100 Stucco Assemblies

1.2  RELATED SECTIONS
A. Section 03 30 00 - Cast-in-Place Concrete
B. Section 04 20 00 - Unit Masonry
C. Section 06 16 00 - Sheathing
D. Section 07 25 00 - Weather Barriers
E. Section 07 62 00 - Sheet Metal Flashing and Trim
F. Section 07 90 00 - Joint Protection
G. Section 08 50 00 - Windows
H. Section 09 21 16 - Gypsum Board Assemblies

1.3  REFERENCES
A. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar
B. ASTM C578 - Specification for Preformed, Cellular Polystyrene Thermal Insulation
C. ASTM C847 - Standard Specification for Metal Lath
E. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster
G. ASTM C1032 - Standard Specification for Woven Wire Plaster Base
H. ASTM C1063 - Standard Specification for Installation of Lathing and Furring for Portland Cement Based Plaster
I. ASTM C1177 - Specification for Glass Mat Gypsum for Use as Sheathing
J. ASTM C1278 - Specification for Fiber-Reinforced Gypsum Panel
K. ASTM C1396 - Standard Specification for Gypsum Board
L. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials
N. ASTM E330 - Test Method for Structural Performance of Windows, Curtain Walls, and Doors by Uniform Static air Pressure Difference
P. ICC Acceptance Criteria 219 - Acceptance Criteria for Exterior Insulation And Finish Systems
Q. ICC Acceptance Criteria 11 - Acceptance Criteria for Cementitious Exterior Wall Coatings

1.1  ASSEMBLY DESCRIPTION
A. El Rey Fastwall 100 Stucco Assembly: A code complying water resistive barrier, wire fabric or metal lath, Fastwall Stucco Base (Fastwall Stucco Base Concentrate or Fastwall Stucco Base Sanded) and an acrylic or elastomeric based finish coat.

-OR-
A. El Rey Fastwall 100 Krakmaster™ Stucco Assembly: A code complying water resistive
barrier, wire fabric or metal lath, Fastwall Stucco Base (Fastwall Stucco Base Concentrate or Fastwall Stucco Base Sanded), Parex USA reinforcing mesh embedded in Level Coat, and an acrylic or elastomeric based finish coat.

1.2 SUBMITTALS

A. General: Submit Samples, Evaluation Reports and manufacturers product datasheets in accordance with Division 1 General Requirements Submittal Section.

B. Samples: Submit samples for approval. Samples shall be of materials specified and of suitable size as required to accurately represent each color and texture used on project. Prepare each sample using same tools and techniques for actual project application. Maintain and make available, at job site, approved samples.

C. Manufacturer's Warranty: Submit sample copies of Manufacturer's Warranty indicating Single Source Responsibility for Water Stucco Base coat, finish coat and optional Primer, level coat and reinforcing mesh as specified.

1.3 QUALITY ASSURANCE

A. Qualifications:
1. Manufacturer: Shall have marketed stucco assemblies in United States for at least five years and shall have completed projects of same general scope and complexity.
2. Applicator: Shall be experienced and competent in installation of stucco materials, and shall provide evidence of a minimum of 5 years experience in work similar to that required by this section.

B. Functional Criteria:
1. General: Stucco application shall be to vertical substrates or to substrates sloped for positive drainage. Substrates sloped for drainage shall have additional protection from weather exposure that might be harmful to coating performance.
2. Testing to meet International Code Council Acceptance Criteria AC11
3. Performance Requirements

<table>
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<th>Fastwall</th>
<th>Method</th>
<th>ICC AC 11 Criteria</th>
<th>Results</th>
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<tr>
<td>Accelerated Weathering</td>
<td>ASTM G153</td>
<td>2000 Hours</td>
<td>No deleterious effect</td>
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<tr>
<td>Freeze-Thaw Resistance</td>
<td>ICC AC 11</td>
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<td>Transverse Wind Load Resistance</td>
<td>ASTM E330</td>
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<td>Refer to ICC-ES ESR-2564</td>
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<td>Fire Resistance</td>
<td>ASTM E119</td>
<td>One hour fire</td>
<td>Refer to ICC-ES ESR-2564</td>
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<td>Drainage</td>
<td>ICC AC 11</td>
<td>90%</td>
<td>Refer to ICC-ES ESR-2564</td>
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<th>Acrylic Finish</th>
<th>Method</th>
<th>ICC or ASTM Criteria</th>
<th>Results</th>
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<tbody>
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<td>ASTM G153 (ASTM G23)</td>
<td>No deleterious effects at 2000 hours when viewed under 5x magnification</td>
<td>2000 Hours: no deleterious effect</td>
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<tr>
<td>Freeze/Thaw Resistance</td>
<td>ASTM E2485</td>
<td>No deleterious effects at 10 cycles when viewed under 5x magnification</td>
<td>60 cycles: no deleterious effect</td>
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<td>Fungus Resistance</td>
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<tr>
<td>Mildew Resistance</td>
<td>ASTM D3273</td>
<td>No growth supported during 28 day exposure period</td>
<td>Pass</td>
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<tr>
<td>Moisture Resistance</td>
<td>ASTM D2247</td>
<td>No deleterious effects at 14 day exposure</td>
<td>Pass</td>
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<tr>
<td>Salt Fog Resistance</td>
<td>ASTM B117</td>
<td>No deleterious effects at 300 hours</td>
<td>500 hours: no deterioration</td>
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C. Substrate Conditions:
1. Substrate materials and construction shall conform to the building code having jurisdiction.
2. Substrates shall be sound, dry and free of dust, dirt, laitance, efflorescence and other harmful contaminants.
3. Substrate Dimensional Tolerances: Flat with ¼ in (6.4 mm) within any 4 ft (1.22 m) radius.
4. Maximum deflection of substrate system under positive or negative design loads shall not exceed L/360 of span.

D. Expansion and Control Joints: Continuous expansion and control joints shall be installed at locations in accordance with ASTM C1063 and ASTM C926.
1. Substrate movement, and expansion and contraction of El Rey Fastwall 100 Stucco and adjacent materials shall be taken into account in design of expansion joints, with proper consideration given to sealant properties, installation conditions, temperature range, coefficients of expansion of materials, joint width to depth ratios, and other material factors. Minimum width of expansion joints shall be as specified by the designer or shown on the project drawings.
2. In accordance with ASTM C1063, expansion or control joints shall be installed in walls not more than 144 ft² (13.4 m²) in area, and not more than 100 ft² (9.3 m²) in area for all non-vertical applications. The distance between joints shall not exceed 18 ft (5.5 m) in either direction or a length-to-width ratio of $2 \frac{1}{2}$ to 1.
3. For direct application to concrete or masonry, stucco joints are required only at control/expansion joints in the underlaying concrete or masonry

1.4 DELIVERY, STORAGE, AND HANDLING
A. Delivery: Deliver Stucco products in original packaging with manufacturer’s identification.
B. Storage: Store Stucco products in a dry location, out of direct sunlight, off the ground, and protected from moisture.

1.5 SITE / ENVIRONMENTAL CONDITIONS
A. Substrate Temperature: Do not apply El Rey products to substrates whose temperature are below 40°F (4.4°C) or contain frost or ice.
B. Inclement Weather: Do not apply El Rey products during inclement weather, unless appropriate protection is employed.
C. Sunlight Exposure: Avoid, when possible, installation of the El Rey products in direct sunlight. Application of El Rey Finishes in direct sunlight in hot weather may adversely affect aesthetics.
D. Do not apply stucco base coats or finishes if ambient temperature falls below 40°F (4°C) within 24 hours of application. Protect stucco from uneven and excessive evaporation during dry weather and strong blasts of dry air.
E. Prior to installation, the wall shall be inspected for surface contamination, or other conditions that may adversely affect the performance of the El Rey Fastwall 100 Stucco Assembly, and shall be free of residual moisture.

1.6 COORDINATION AND SCHEDULING:
A. Coordination: Coordinate Stucco Assembly installation with other construction operations.

1.7 WARRANTY
A. Warranty: Upon request, at completion of installation, provide Standard Limited El Rey Fastwall 100 Stucco Assembly Warranty.

EDITOR NOTE: SEE EL REY’S WARRANTY SCHEDULE FOR AVAILABLE WARRANTIES.

PART 2 - PRODUCTS
2.1 MANUFACTURERS
A. Manufacturer: Parex USA, Inc., 4125 E. La Palma Ave., Suite 250, Anaheim, CA 92807
B. Components: Obtain components manufactured by Parex USA of El Rey Fastwall 100 Stucco Assembly from authorized distributors. No substitutions or additions of other materials are permitted without prior written permission from Parex USA for this project.

2.2 MATERIALS
A. El Rey Fastwall 100 Stucco Assembly Materials:
   1. El Rey Fastwall 100 Stucco Base (¾ in – ½ in -one coat)
      a. El Rey Fastwall Stucco Base Concentrate: Proprietary mixture of portland cement, and proprietary ingredients mixed with clean, cool, potable water, and ASTM C897 or ASTM C144 sand added in the field.
      -OR-
      a. El Rey Fastwall Stucco Base Sanded: Proprietary mixture of portland cement, and proprietary ingredients mixed with clean, cool, potable water in the field.

EDITOR NOTE: MODIFY BELOW TO SUIT REQUIREMENTS. CHOOSE OPTIONAL PAREX USA ADACRYL BONDER & ADMIX FOR ENHANCED PERFORMANCE

B. Parex USA Adacryl Bonder & Admix: 100% acrylic admix emulsion for portland cement based products, to enhance curing, adhesion, freeze-thaw resistance and workability.

EDITOR NOTE: MODIFY BELOW TO SUIT REQUIREMENTS. CHOOSE LEVELING AND REINFORCING COAT FOR ENHANCED CRACK RESISTANCE PERFORMANCE.

C. Leveling and Reinforcing Coat (Required for El Rey Fastwall 100 Krakmaster Stucco Assembly): *NOT FOR USE ON EPS FOAM SHAPES
   1. Parex USA Stucco Level Coat™: Copolymer based, factory blend of cement and proprietary ingredients requiring addition of water.
   2. Parex WeatherDry: Waterproof Base coat mixed with portland cement in the field.
   3. Parex USA 355 Standard Mesh: Weight 4.5 oz/yd² (153 g/m²) reinforcing mesh.

STUCCO LEVEL COAT SHALL NOT BE USED AS AN ADHESIVE OR BASE COAT FOR EXPANDED POLYSTYRENE INSULATION BOARD SHAPES OR FEATURES

EDITOR NOTE: MODIFY BELOW TO SUIT REQUIREMENTS. CHOOSE EL REY ACRYLIC PRIMER FOR EXTENDED WARRANTY – FOR USE WITH ACRYLIC OR ELASTOMERIC FINISHES OR COATINGS ONLY

D. Perma-Flex Colored Primer: 100% acrylic based coating to prepare surfaces for El Rey finishes.

EDITOR NOTE: MODIFY BELOW TO SUIT REQUIREMENTS. CHOOSE ONE FINISH TYPE CHOOSE EL REY ELASTOMERIC OR ACRYLIC FINISH FOR DIFFERENT LEVELS OF ENHANCED WARRANTY.

E. El Rey Finish:
   1. El Rey Perma-Flex Elastomeric Finish: Factory blended, 100 % acrylic polymer based elastomeric textured finish, integrally colored.
      a. Finish texture and color as selected by Project Designer
-OR-

1. El Rey Perma-Flex DPR Acrylic Finish: Factory blended, 100% acrylic polymer based finish, integrally colored.
   a. Finish texture and color as selected by Project Designer

2.3 RELATED MATERIALS AND ACCESSORIES

A. General: El Rey Fastwall 100 Stucco Assembly and its related materials shall conform to the requirements of ICC-ES Evaluation Report No. 2564 and shall conform to this specification.

B. Substrate Materials:
   1. Gypsum Sheathing: Minimum ½ in (13 mm) thick, core-treated, weather-resistant, exterior gypsum sheathing complying with ASTM C79 or ASTM C1177.
   2. Cement Board Sheathing, Minimum ½ in (13 mm) thick, conforming to ASTM C1186.
   3. Fiberboard: Minimum ½ in (13 mm) thick fiberboard complying with ANSI/AHA A194.1 as a regular density sheathing.
   4. Plywood: Minimum 5/16 in (8 mm) thick exterior grade or Exposure I plywood for studs spaced 16 in (406 mm) o.c. and ¾ in (9.5 mm) thick exterior type plywood minimum for studs spaced 24 in (610 mm) o.c. Plywood shall comply be exterior grade or Exposure 1 and comply with DOC PS-1
   5. Oriented Strand Board (OSB): 7/16 - ½ in Wall-16 or Wall-24, approved by the APA, TECO, or PSI/PTL. Stamped as Exposure 1 or Exterior Sheathing with a PS2 or PRP-108 rating. The system is qualified for application to OSB (oriented strand board) sheathing only in areas shown in the Parex USA “Acceptable Substrates and Areas of Use” Technical Bulletin.
   6. Concrete Masonry Construction: Painted (coated) and non-painted (uncoated). Shall be in conformance with the building code.
   7. Other Approved by Parex USA in writing prior to the project

C. Water Resistive Barriers:
   1. For non-wood based sheathing shall be either:
      a. 1 layer asphalt-saturated felt complying with ASTM D 226 Type I.
      b. Lath with appropriate paper backing
      c. Other recognized equivalent
   2. For wood based sheathing shall be either:
      a. 2 layers of Grade D asphalt saturated Kraft building paper, or 1 layer of the Kraft building paper plus paper backed lath
      b. Grade D paper with a water resistance equal to or greater than 60 minutes, with an intervening non-water-absorbing layer or drainage space.
      c. Other recognized equivalent
   3. Open Framing:
      a. 1 layer Grade D asphalt saturated Kraft building paper.
      b. 1 layer asphalt-saturated felt complying with ASTM D 226 Type I.
      c. Other recognized equivalent

EDITOR NOTE: THE SELECTION OF AN APPROPRIATE TYPE OF MATERIAL FOR ACCESSORIES SHALL BE DETERMINED BY APPLICABLE SURROUNDING CLIMATIC AND ENVIRONMENTAL CONDITIONS SPECIFIC TO THE PROJECT LOCATION, SUCH AS SALT AIR, INDUSTRIAL POLLUTION, HIGH MOISTURE, OR HUMIDITY.
D. Lath and Accessories: Conform to ASTM C847, ASTM C933, ASTM C1032, ASTM C1063 and Appendix
   1. Accessories: Manufacturer’s standard steel products with minimum G60 galvanizing unless otherwise indicated as rigid polyvinyl chloride (PVC plastic) or zinc alloy

EDITOR NOTE: SELECT LATH TYPE AND WEIGHT.
   2. Metal Plaster Bases: Minimum 17 gauge self-furred stucco netting, minimum 2.5 lb/yd² (1.4 kg/m²) or 3.4 lb/yd² (1.8 kg/m²) expanded metal diamond lath, or welded wire lath in accordance with applicable codes and standards.
   3. Weep Screeds: Foundation weep screed with minimum 3-½ inch vertical attachment flange.

EDITOR NOTE: THE SELECTION AND USE OF AN APPROPRIATE TYPE OF SEALANT SHALL BE DETERMINED BY APPLICABLE SURROUNDING CLIMATIC AND ENVIRONMENTAL CONDITIONS SPECIFIC TO THE PROJECT LOCATION.

E. Expanded Polystyrene Features over El Rey Fastwall 100 Stucco
   1. Adhesive and Base Coat
      a. El Rey Insul-bond: Modified portland cement adhesive and basecoat for exterior foam shapes, such as pop-outs, plant-ons, cornices and reveals mixed with water.
   2. Insulation Board
      a. Produced and labeled under a third party quality program as required by applicable building code and produced by a manufacturer approved by Parex USA.
      b. Shall conform to ASTM C578, ASTM E2430 Type I, and the Parex USA specification for Molded Expanded Polystyrene Insulation board.
   3. Reinforcing Mesh
      a. Parex USA Standard Mesh: Weight 4.5 oz/yd² (153 g/m²) reinforcing mesh.

F. Seals, Sealants and Bond Breakers: Sealants shall conform to ASTM C920, Grade NS, Class 25, Use NT. Backer rod shall be closed-cell polyethylene foam.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify project site conditions under provisions of Section 01 00 00.
   B. Compliance: Comply with manufacturer's instructions for installation of El Rey Fastwall 100 Stucco Assembly products.

REMINDER: EL REY FASTWALL 100 STUCCO ASSEMBLY MUST INSTALLED OVER A CODE COMPLYING WATER RESISTIVE BARRIER OR SOLID SURFACE OF MASONRY OR CONCRETE. WALL PERFORMANCE IS DEPENDENT UPON, AMONG OTHER FACTORS, PROPER FLASHING AND JOINT SEALING, AND ATTENTION TO PROPER FLASHING AND JOINT SEALANT DETAILS INDICATED ON DRAWINGS.

C. Substrate Examination: Examine prior to El Rey Fastwall Stucco Base installation as follows:
   1. Substrate shall be of a type approved by Parex USA. Plywood and OSB substrates shall be gapped % in (3.2 mm) at all edges.
   2. Substrate shall be examined for soundness, and other harmful conditions.
   3. Substrate shall be free of dust, dirt, laitance, efflorescence, and other harmful contaminants.
   4. Substrate construction in accordance with substrate material manufacturer's
specifications and applicable building codes.
D. Advise Contractor of discrepancies preventing installation of the El Rey Fastwall 100 Stucco Assembly. Do not proceed with the El Rey Fastwall 100 Stucco Assembly work until unsatisfactory conditions are corrected.
E. Ensure that flashing has been installed per Specification Section 07 60 00 - Flashing and Sheet Metal.

3.2 PREPARATION
A. Water Resistive Barrier:
   1. The Water Resistive Barrier is placed over all substrates except concrete or unpainted masonry. Painted (coated) CMU is to use a bond breaker such as asphalt paper and lath if the paint or coating cannot be removed.
   2. Installed according to manufacturers instructions.

IMPORTANT: COORDINATE TERMINATIONS OF STUCCO ACCESSORIES WITH SEALANT SECTION OF THE SPECIFICATION IN ORDER TO LEAVE REQUIRED SPACINGS FOR SPECIFIED JOINT DIMENSIONS.
C. Concrete (Cast-in-Place): Provide a surface that is slightly scarified, water absorbent, straight and true to line and plane. Remove form ties and trim projecting concrete so it is even with the plane of the wall. Remove form release agents.
D. Concrete Masonry Units: Remove projecting joint mortar so it is even with the plane of the wall. Remove surface contaminants such as efflorescence, existing paint or any other bond inhibiting material by sandblasting, waterblasting, wire brushing, chipping or other appropriate means. Pre-moisten the surface with water just prior to placement of stucco, or apply Parex USA Adacryl Bonder & Admix.

3.3 MIXING
A. Mix El Rey proprietary products in accordance with manufacturer's instructions, including the applicable El Rey Fastwall 100 Stucco Assembly Product Data Sheets.
B. Admix - Parex USA Adacryl Bonder & Admix
   Mix up to 1 gal (3.8 L) per 1 bag of El Rey Fastwall Stucco Concentrate. Mix up to 1 qt (1 L) per bag of El Rey Fastwall Sanded. Add after dry components and the majority of the water has been mixed. Mix no longer than required to provide a uniform mixture. DO NOT OVER-MIX. Overmixing entrains excessive amounts of air which weaken the material. Do not re-temper mixes over 20 minutes old.

3.4 APPLICATION
A. General: El Rey Fastwall 100 Stucco Assembly and its related materials shall conform to the requirements of ICC-ES Evaluation Report No. 2564 and shall conform to this specification.
B. Bonding Agent - Parex USA Adacryl Bonder & Admix
   1. Apply at an approximate rate of 250 ft² per gallon using a low-pressure sprayer, brush or roller. (application in direct sunlight may cause the product to dry too quickly)
C. El Rey Fastwall Stucco Base:
   1. Either El Rey Fastwall Stucco mixtures shall be applied in one or two coats to a minimum thickness of ⅜ in (9.5 mm) by hand troweling or machine spraying the mixture to the wire lath in accordance with El Rey Fastwall Stucco Product Data Sheets. The maximum thickness applied in one pass is ½ in (12.7 mm).
   2. Rod surface to true plane and float to densify.
   3. Trowel to smooth and uniform surface to receive acrylic polymer finish coat.
EDITOR NOTE: MODIFY BELOW TO SUIT REQUIREMENTS. CHOOSE EL REY FASTWALL LEVELING AND REINFORCING COAT FOR ENHANCED CRACK RESISTANCE PERFORMANCE (D.) FOR ENHANCED CRACK RESISTANCE PERFORMANCE.

D. Leveling and Reinforcing Coat (El Rey Fastwall 100 Krakmaster Stucco Assembly):
   1. After Moist Curing, allow El Rey Fastwall Stucco Base to air dry a minimum of 24 hours before applying the leveling and reinforcing coat.
   2. Using a stainless steel trowel, apply the El Rey Level Coat over the Stucco Base at a thickness of $\frac{1}{16}$ – $\frac{3}{32}$ in. (1.6 – 2.4 mm).
   3. Fully embed the Parex USA Standard Mesh into the wet Stucco Level Coat including diagonal strips at corners of openings and trowel smooth. If Standard Mesh is used, seams are overlapped 2½ in (63 mm).
   4. The El Rey acrylic primer and finishes can be applied as soon as the Parex USA Stucco Level Coat has cured, typically within 24 hours.

E. Expanded Polystyrene Featured over El Rey Fastwall Stucco Base:
   1. Install back-wrap mesh at EPS terminations.
   2. Apply El Rey adhesive to backs of insulation boards with a notched trowel. Allow to dry a minimum of 12 hours.
   3. Apply El Rey Base coat to the entire foam shape and pull the backwrap mesh around the foam shapes and fully embed it into the base coat.
   4. Immediately embed the reinforcing mesh in the wet El Rey Base coat.

F. El Rey Primer and Finish:
   1. Remove surface contaminants such as dust or dirt without damaging the substrate.
   2. Ambient and surface temperature must be 40°F (4°C) or higher during application and drying time. Supplemental heat and protection from precipitation must be provided as needed.
   3. Use only on surfaces that are sound, clean, dry, unpainted, and free from any residue that might affect the ability of the finish to bond to the surface.

EDITOR NOTE: MODIFY BELOW TO SUIT REQUIREMENTS. CHOOSE ONE #4

4. El Rey Fastwall 100 Krakmaster Stucco Assembly
   a. Before the application of the finish, the base coat must have cured a minimum of 24 hours or longer as required by weather conditions. Examine the cured base coat for any irregularities.
   b. Correct these irregularities to produce a flat surface.
   -OR-
   4. El Rey Fastwall 100 Stucco Assembly
   a. After Moist curing, allow the El Rey FastWall Stucco Base to air dry.
      (1) Minimum of 3 additional days if applying a Primer
      -OR-
      (1) Minimum of 5 additional days before application of an Acrylic or Elastomeric based Finish Coat

5. Protect El Rey Finish Coats from inclement weather until completely dry.

G. Curing:
   1. El Rey Fastwall Stucco Base: Keep stucco moist for at least 48 hours (longer in dry weather) by lightly fogging walls. Start light fogging after initial set of 1–2 hours.
2. Air dry acrylic based and elastomeric finish coats only, do not wet cure.

3.5 CLEAN-UP
A. Removal: Remove and legally dispose of El Rey Fastwall 100 Stucco component debris material from job site.

3.6 PROTECTION
A. Provide protection of installed materials from water infiltration into or behind them.
B. Provide protection of installed stucco from dust, dirt, precipitation, and freezing during installation.
C. Provide protection of installed finish from dust, dirt, precipitation, freezing, and continuous high humidity until fully dry.
D. Clean exposed surfaces using materials and methods recommended by the manufacturer of the material or product being cleaned. Remove and replace work that cannot be cleaned to the satisfaction of the Designer/Owner.

END OF SECTION 09240
SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.
4. Texture finishes.

B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
3. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
4. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

C. Samples for Initial Selection: For each type of trim accessory and textured finish indicated.

D. Samples for Verification: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.
1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C 1396/C 1396M.
   1. Acceptable Manufacturers:
      a. American Gypsum
      b. CertainTeed Corporation
      c. Georgia Pacific
      d. United States Gypsum Company
   2. Thickness: 1/2 inch (12.7 mm).

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
   1. Acceptable Manufacturers:
      a. American Gypsum
      b. CertainTeed Corporation
      c. Georgia Pacific
      d. United States Gypsum Company
   2. Thickness: 5/8 inch (15.9 mm).

C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
   1. Acceptable Manufacturers:
      a. American Gypsum
      b. CertainTeed Corporation
      c. Georgia Pacific
      d. United States Gypsum Company
   2. Thickness: 1/2 inch (12.7 mm).

D. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
   1. Acceptable Manufacturers:
      a. American Gypsum
      b. CertainTeed Corporation
      c. Georgia Pacific
      d. United States Gypsum Company
   2. Core: 5/8 inch (15.9 mm), Type X.
   4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
   5. Long Edges: Tapered.

2.4 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
   1. Acceptable Manufacturers:
      a. American Gypsum
      b. CertainTeed Corporation
      c. Georgia Pacific
      d. United States Gypsum Company
   2. Core: 5/8 inch (15.9 mm), Type X.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.

2. Shapes:
   a. Corner bead.
   b. Bullnose bead.
   c. LC-Bead: J-shaped; exposed long flange receives joint compound.
   d. L-Bead: L-shaped; exposed long flange receives joint compound.
   e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
   f. Expansion (control) joint.
   g. Curved-Edge Corner bead: With notched or flexible flanges.


1. Material: Hot-dip galvanized-steel sheet, plastic, or rolled zinc.

2. Shapes:
   a. Corner bead.
   b. LC-Bead: J-shaped; exposed long flange receives joint compound.
   c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.

2. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
   a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use use setting-type taping or drying-type, all-purpose compound.
4. Finish Coat: For third coat, use use setting-type taping or drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type taping or drying-type, all-purpose compound.
6. Joint Compound for Exterior Applications:
7. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
8. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

D. Joint Compound for Tile Backing Panels:
1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.
3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

G. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."
2.8 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.

C. Acoustical Finish: Water-based, chemical-setting or drying-type, job-mixed texture finish for spray application
   1. Application Thickness: 1/2 inch (12.7 mm).
   2. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 50 or less.
   3. NRC: 0.55 according to ASTM C 423.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.
F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: As indicated on Drawing and vertical surfaces unless otherwise indicated.
2. Type X: As indicated on Drawings and where required for fire-resistance-rated assembly.
3. Flexible Type: As indicated on Drawings.
4. Ceiling Type: As indicated on Drawings.
5. Foil-Backed Type: As indicated on Drawings.
6. Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
   
a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
   
1. Install with 1/4-inch (6.4-mm) open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.5 APPLYING TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

B. Water-Resistant Backing Board: Install where indicated with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:
   
1. Cornerbead: Use at outside corners.
2. Bullnose Bead: Use at outside corners.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.
5. U-Bead: Use at exposed panel edges and where indicated.
6. Curved-Edge Cornerbead: Use at curved openings.

D. Exterior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners.
   2. LC-Bead: Use at exposed panel edges.

E. Aluminum Trim: Install in locations indicated on Drawings.

3.7 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints[, rounded or beveled edges,] and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile.
   3. Level 3: Where indicated on Drawings.
   4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
      a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.8 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture[ matching approved mockup and] free of starved spots or other evidence of thin application or of application patterns.

C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite
these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written instructions.

3.9 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900
SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Pressed floor tile.
   2. Glazed wall tile.
   3. Tile backing panels.
   4. Waterproof membrane for thinset applications.
   5. Crack isolation membrane.
   6. Metal edge strips.

B. Related Requirements:
   1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
   2. Section 092400 "Cement Plastering" for scratch coat for thickset mortar setting-bed installations.
   3. Section 092900 "Gypsum Board" for cementitious backer units.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.


C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507.
1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

C. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required.
   2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches (300 mm) square but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
   3. Full-size units of each type of trim and accessory.
   4. Stone thresholds in 6-inch (150-mm) lengths.
   5. Metal edge strips in 6-inch (150-mm) lengths.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full-size units equal to 5 percent of amount installed for each type, composition, color, pattern, and size indicated.
   2. Grout: Furnish quantity of grout equal to 5 percent of amount installed for each type, composition, and color indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile from single source or producer.
   1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
   1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
   2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
   1. Stone thresholds.
   2. Waterproof membrane.
   3. Crack isolation membrane.
   4. Cementitious backer units.
   5. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
   1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
   1. Where tile is indicated for in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
2.3 TILE PRODUCTS

A. Ceramic Floor Tile: Factory-mounted unglazed ceramic mosaic tile.
   1. Acceptable Manufacturers:
      a. American Olean
      b. Daltile
      c. Interceramic
      d. Architect approved Substitution
   2. Composition: Vitreous or impervious natural clay or porcelain.
   3. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
   5. Thickness: 1/4 inch (6.4 mm).
   6. Face: Plain with cushion edges.
   7. Surface: As selected by Architect from manufacturer's full range.
   8. Dynamic Coefficient of Friction: Not less than 0.42.
   9. Finish: As selected by Architect from manufacturer's full range.
   10. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
   11. Grout Color: As selected by Architect from manufacturer's full range.

2.4 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
   1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

2.5 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A, in maximum lengths available to minimize end-to-end butt joints.
   1. Acceptable manufactures:
      a. Georgia Pacific
      b. United States Gypsum
   2. Thickness: 1/2 inch (12.7 mm).

2.6 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric.
   1. Nominal Thickness: 0.030 inch (0.76 mm).
2.7 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for [standard performance] [high performance] and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch (0.76-mm) nominal thickness.

2.8 SETTING MATERIALS


1. Cleavage Membrane: Asphalt felt, ASTM D 226/D 226M, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.

2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062-inch (1.57-mm) diameter; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.

   a. Base Metal and Finish for Interior Applications: Uncoated or zinc-coated (galvanized) steel sheet, with uncoated steel sheet painted after fabrication into lath.
   c. Configuration over Studs and Furring: Flat.
   e. Weight: 2.5 lb/sq. yd. (1.4 kg/sq. m).

4. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.

1. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.

C. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.

3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

D. Medium-Bed, Modified Dry-Set Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch (16 mm).
1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with latex additive at Project site.

2.9 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.


C. High-Performance Tile Grout: ANSI A118.7.
   1. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
   2. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.

D. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
   1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.

E. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.10 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.

C. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.11 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.
C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed comply with surface finish requirements in ANSI A108.01 for installations indicated.

   a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.

   b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.

4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

   a. Tile floors in wet areas.
   b. Tile floors in laundries.
   c. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
   d. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

   1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
   2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

   1. Pressed Floor Tile: 1/4 inch (6.4 mm).
   2. Glazed Wall Tile: 1/16 inch (1.6 mm).

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
   1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in improved modified dry-set mortar (thinset).
   2. Do not extend waterproofing or crack isolation membrane under thresholds set in standard dry-set, modified dry-set or improved modified dry-set mortar.

K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

L. Floor Sealer: Apply floor sealer according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 TILE BACKING PANEL INSTALLATION
   A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 WATERPROOFING INSTALLATION
   A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
   B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.6 CRACK ISOLATION MEMBRANE INSTALLATION
   A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
   B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.7 ADJUSTING AND CLEANING
   A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.8 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 093013
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Acoustical tiles for interior ceilings.
   2. Fully concealed, direct-hung, suspension systems.

B. Related Requirements:
   1. Section 095113 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.

C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

C. Samples for Initial Selection: For components with factory-applied finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
   1. Acoustical Tiles: Set of full-size Samples of each type, color, pattern, and texture.
   2. Concealed Suspension-System Members: 6-inch- (150-mm-) long Sample of each type.
   3. Exposed Moldings and Trim: Set of 6-inch- (150-mm-) long Samples of each type and color.

E. Delegated-Design Submittal: For seismic restraints for ceiling systems.
   1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
   a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size tiles equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each concealed grid and exposed component equal to 2 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical tile ceiling installation.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations:
   1. Suspended Acoustical Tile Ceilings: Obtain each type of acoustical ceiling tile and its
      suspension system from single source from single manufacturer.
   2. Directly Attached Acoustical Tile Ceilings: Obtain each type of acoustical ceiling tile
      from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions
determined according to ASCE/SEI 7.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing
   agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: Class A according to ASTM E 1264.
   2. Smoke-Developed Index: 50 or less.

C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency.
   Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL or from the listings of another qualified testing
      agency.

2.3 ACOUSTICAL TILES

A. Acceptable Manufacturers include the following:
   1. Armstrong World Industries
   2. CertainTeed Corporation
   3. United States Gypsum Companies

B. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that
   comply with ASTM E 1264 classifications as designated by type, form, pattern, acoustical
   rating, and light reflectance unless otherwise indicated.

C. Classification: Provide[ fire-resistance-rated] tiles as follows:
   1. Type and Form: Type III, mineral base with painted finish.
   2. Pattern: as indicated by manufacturer's designation.

D. Color: Match Architect's sample.

E. Light Reflectance (LR): Not less than 0.70.

F. Ceiling Attenuation Class (CAC): Not less than 30.
G. Noise Reduction Coefficient (NRC): Not less than 0.60.

H. Articulation Class (AC): Not less than 180.

I. Edge/Joint Detail: As indicated by manufacturer's designation

J. Thickness: 5/8 inch (15 mm).

K. Modular Size: As indicated on Drawings.

L. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEM <Insert drawing designation>

A. Acceptable Manufacturers include the following:
   1. Armstrong World Industries
   2. United States Gypsum Companies

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, fully concealed, metal suspension system and accessories of type, structural classification, and finish indicated that complies with applicable requirements in ASTM C 635/C 635M.

   1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" according to ASTM C 635/C 635M.

C. Direct-Hung, Double-Web, Fire-Rated Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation.

   2. Access: Upward and end pivoted, with initial access openings of size indicated below and located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical tiles.

      a. Initial Access Opening: In each module, 24 by 24 inches (610 by 610 mm)

2.5 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

   1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to [five] <Insert safety factor> times that imposed by ceiling construction, as determined by testing according to ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
a. Type: Post installed expansion anchors.

b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B 633, Class SC 1 (mild) service condition.

c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:


2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.

3. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- (2.69-mm-)diameter wire.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch-(1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate lateral forces.

H. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical tiles in-place during a seismic event.

2.6 METAL EDGE MOLDINGS AND TRIM <Insert drawing designation>

A. Acceptable Manufacturers include the following:

1. Armstrong World Industries

2. United States Gypsum Companies

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.
1. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
2. Finish: Painted to match color of acoustical unit.

C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.

1. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.

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

3.2 PREPARATION

A. Testing Substrates: Before adhesively bonding tiles to wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's recommended limits.

B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

C. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. Install suspended acoustical tile ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions.

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
B. Suspend ceiling hangers from building's structural members and as follows:

1. 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.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
F. Arrange directionally patterned acoustical tiles as follows:

1. As indicated on reflected ceiling plans.
2. Install tiles with pattern running in one direction parallel to short axis of space.
3. Install tiles in a basket-weave pattern.

G. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges of tiles so tile-to-tile joints are interlocked.

1. Fit adjoining tiles to form flush, tight joints. Scribe and cut tiles for accurate fit at borders and around penetrations through ceiling.
2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tiles and moldings, spaced 12 inches (305 mm) o.c.
3. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m) non-cumulative.

B. Directly Attached Ceilings: Install bottom surface of tiles to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m) and not exceeding 1/4 inch (6 mm) cumulatively.

C. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

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

C. Perform the following tests and inspections of completed installations of acoustical tile ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no tiles have been installed. Do not proceed with installations of acoustical tile ceiling hangers for the next area until test results for previously completed installations of acoustical tile ceiling hangers show compliance with requirements.

1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Acoustical tile ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6  ADJUSTING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095123
SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes modular carpet tile.

B. Related Requirements:
   1. Section 096513 "Resilient Base and Accessories” for resilient wall base and accessories installed with carpet tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
   2. Include manufacturer's written installation recommendations for each type of substrate.

B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

   2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

C. Samples for Initial Selection: For each type of carpet tile.

   1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.

D. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

   2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.
E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.


1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.

2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups at locations and in sizes shown on Drawings.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI's "CRI Carpet Installation Standard."
1.9 FIELD CONDITIONS

A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.

2. Failures include, but are not limited to, the following:
   a. More than 10 percent edge raveling, snags, and runs.
   b. Dimensional instability.
   c. Excess static discharge.
   d. Loss of tuft-bind strength.
   e. Loss of face fiber.
   f. Delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Acceptable Manufacturers include:
   1. Interface LLC
   2. Mannington Mills
   3. Mohawk Group
   4. Shaw Contract Group

B. Color: As indicated by manufacturer's designations

C. Pattern: Match Architect's samples.
D. Fiber Content: Match Architect's samples.
E. Fiber Type: Match Architect's samples.
F. Pile Characteristic: Match Architect's samples.
G. Density: Match Architect's samples.
H. Pile Thickness: Match Architect's samples and according to ASTM D 6859.
I. Total Weight: Match Architect's samples.
J. Primary Backing/Backcoating: Manufacturer's standard composite materials
K. Secondary Backing: Manufacturer's standard material
L. Size: 24 by 24 inches (610 by 610 mm)
M. Applied Treatments:
   1. Soil-Resistance Treatment: Manufacturer's standard treatment
   2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
      a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

2.2 INSTALLATION ACCESSORIES
A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

   a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
   b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
   c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.

B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813
SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes surface preparation and the application of paint systems on exterior substrates.
B. Related Requirements:
   1. Section 051200 "Structural Steel Framing" and Section 051213 "Architecturally Exposed Structural Steel Framing" for shop priming of metal substrates.
   2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
   3. Section 055213 "Pipe and Tube Railings" for shop priming and painting pipe and tube railings.
   4. Section 099600 "High-Performance Coatings" for tile-like coatings.
   5. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on exterior wood substrates.

1.3 DEFINITIONS
A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product. Include preparation requirements and application instructions.
1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
   1. Submit Samples on rigid backing, 8 inches (200 mm) square.
   2. Apply coats on Samples in steps to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
      b. Other Items: Architect will designate items or areas required.
   2. Final approval of color selections will be based on mockups.
      a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers include the following:
   1. Benjamin Moore
   2. Dunn Edwards
   3. Glidden
   4. Sherwin Williams

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:
   1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As selected by Architect from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If
paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.

3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
5. Portland Cement Plaster: 12 percent.
6. Gypsum Board: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

D. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
   1. SSPC-SP 2.
   2. SSPC-SP 3.
   3. SSPC-SP 7/NACE No. 4.
   4. SSPC-SP 11.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:
   1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
   2. Sand surfaces that will be exposed to view, and dust off.
   3. Prime edges, ends, faces, undersides, and backsides of wood.
   4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
   1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:
   a. Equipment, including panelboards and switch gear.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Per Architectural Finish Schedule.

END OF SECTION 099113
SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" and Section 051213 "Architecturally Exposed Structural Steel Framing" for shop priming structural steel.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
3. Section 055213 "Pipe and Tube Railings" for shop priming and painting pipe and tube railings.
4. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.
1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
   2. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
   1. Submit Samples on rigid backing, 8 inches (200 mm) square.
   2. Apply coats on Samples in steps to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
      b. Other Items: Architect will designate items or areas required.
   2. Final approval of color selections will be based on mockups.
      a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers include the following:
   1. Benjamin Moore
   2. Dunn Edwards
   3. Glidden
   4. Sherwin Williams

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
B. Material Compatibility:
   1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
C. Colors: As selected by Architect from manufacturer's full range

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
   1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If
paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.

3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
5. Gypsum Board: 12 percent.
6. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.

F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

G. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

1. SSPC-SP 2.
2. SSPC-SP 3.
3. SSPC-SP 7/NACE No. 4.
4. SSPC-SP 11.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:
   a. Equipment, including panelboards
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Tanks that do not have factory-applied final finishes.
   h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:
   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.
3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Per Architectural Finish Schedule
SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Public-use washroom accessories.
   2. Custodial accessories.

1.3 COORDINATION
A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Include electrical characteristics.
B. Samples: Full size, for each exposed product and for each finish specified.
   1. Approved full-size Samples will be returned and may be used in the Work.
C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated.
   2. Identify accessories using designations indicated.
1.5  INFORMATIONAL SUBMITTALS
   A.  Sample Warranty: For manufacturer's special warranty.

1.6  CLOSEOUT SUBMITTALS
   A.  Maintenance Data: For accessories to include in maintenance manuals.

1.7  WARRANTY
   A.  Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
      1.  Failures include, but are not limited to, visible silver spoilage defects.
      2.  Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1  OWNER-FURNISHED MATERIALS
   A.  Owner-Furnished Materials: None

2.2  PERFORMANCE REQUIREMENTS
   A.  Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3  PUBLIC-USE WASHROOM ACCESSORIES
   A.  Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
   B.  Combination Towel (Folded) Dispenser/Waste Receptacle:
      1.  Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
         a.  Designed for nominal 4-inch (100-mm) wall depth.
      3.  Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
      5.  Material and Finish: Stainless steel, No. 4 finish (satin).
      6.  Liner: Reusable, vinyl waste-receptacle liner
      7.  Lockset: Tumbler type for towel-dispenser compartment
   C.  Liquid-Soap Dispenser:
1. Description: Designed for dispensing antibacterial soap in liquid or lotion form.
4. Lockset: Tumbler type.
5. Refill Indicator: Window type.

D. Grab Bar:
1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
   a. Finish: Smooth, No. 4 finish (satin).
3. Outside Diameter: 1-1/2 inches (38 mm).
4. Configuration and Length: As indicated on Drawings

E. Sanitary-Napkin Disposal Unit:
1. Mounting: Surface mounted.
2. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.

F. Seat-Cover Dispenser:
1. Mounting: Surface mounted.
4. Lockset: Tumbler type.

G. Mirror Unit:
1. Frame: Stainless-steel angle, 0.05 inch (1.3 mm) thick.
   a. Corners: Manufacturer's standard.
   a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
   b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
3. Size: As indicated on Drawings.

2.4 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

B. Mop and Broom Holder:
1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
2. Length: 36 inches (914 mm).
3. Hooks: **Four**.


5. Material and Finish: Stainless steel, No. 4 finish (satin).
   
   a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
   
   b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

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### 2.5 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.


F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

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### 2.6 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

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### PART 3 - EXECUTION

#### 3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800
SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Owner-Furnished Material: fire extinguishers.

C. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."
2. Section 233813 "Commercial-Kitchen Hoods" for fire-extinguishing systems provided as part of commercial-kitchen exhaust hoods.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507. Zia Pueblo.

1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:

a. Schedules and coordination requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.5 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.
1.6 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.7 COORDINATION
   A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.8 WARRANTY
   A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

       1. Failures include, but are not limited to, the following:

           a. Failure of hydrostatic test according to NFPA 10.
           b. Faulty operation of valves or release levers.

       2. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

   B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

       1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS
   A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

       1. Manufacturers:
         a. Amerex
         b. JL Industries
         c. Larsons
         d. Architect approved equal

       2. Valves: Manufacturer's standard

       3. Handles and Levers: Manufacturer's standard
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Stored-Pressure Water Type UL-rated 2-A, 2.5-gal. (9.5-L) nominal capacity, with water in stainless-steel container; with pressure-indicating gage.

C. Regular Dry-Chemical Type UL-rated nominal capacity, with sodium bicarbonate-based dry chemical in manufacturer's standard enameled container.

D. Multipurpose Dry-Chemical Type UL-rated nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

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

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: [54 inches (1372 mm)] above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
SECTION 107516 - GROUND-SET FLAGPOLES

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes ground-set flagpoles made from aluminum.
   B. Owner-Furnished Material: Flags.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.
   B. Shop Drawings: For flagpoles.
      1. Include plans, elevations, and attachment details. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.
      2. Include section, and details of foundation system.
   C. Samples for Verification: For each type of exposed finish, in manufacturer's standard sizes.
   D. Delegated-Design Submittal: For flagpoles.

1.4 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design flagpole assemblies.

B. Seismic Performance: Flagpole assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.

1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location as per Design Criteria
2. Base flagpole design on nylon or cotton flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

2.3 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: Cone-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).

1. Acceptable manufacturers include the following:
   a. Acme/Lingo Flagpoles
   b. American Flagpoles
   c. U.S Flag and Flagpole Supply
   d. Architect approved Substitution

B. Exposed Height: 20 feet (6 m)

C. Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:

1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.

D. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, 0.060-inch (1.52-mm) wall thickness with 3/16-inch (4.8-mm) steel bottom plate and support plate; 3/4-inch- (19-mm-) diameter, steel ground spike; and steel centering wedges welded together. Galvanize foundation tube after assembly. Furnish loose hardwood wedges at top of foundation tube for plumbing pole.
1. Flashing Collar: Same material and finish as flagpole.

E. Sleeve for Aluminum Flagpole: Fiberglass or PVC pipe foundation sleeve, made to fit flagpole, for casting into concrete foundation.

1. Flashing Collar: Same material and finish as flagpole.

F. Cast-Metal Shoe Base: Made from aluminum with same finish and color as flagpoles for anchor-bolt mounting; furnish with anchor bolts.

1. Furnish ground spike.

G. Hinged Baseplate: Cast-metal tilting hinged base and anchor plate joined by permanently secured pivot rod. Furnish with stainless-steel screws for securing tilting base to anchor plate when not tilted; furnish with anchor bolts.

1. Finish: Same as flagpole.
2. Furnish aluminum base or aluminum flashing collar finished to match flagpole.
3. Furnish ground spike.

H. Pivoting Tilt Base: Steel baseplate with channel or rectangular tube uprights, pivot bolt, and locking device for tilting flagpole. Furnish tilting flagpole with steel counterweight box and weights, or furnish with internal counterweight. Furnish base with anchor bolts.

1. Finish: Same as flagpole.
2. Furnish ground spike.

2.4 FITTINGS

A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-but diameter.

1. 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole.
2. 20-oz. (0.70-mm) copper with 23-karat, gold-leaf finish.
3. Spun stainless steel, finished to match flagpole.
4. Spun copper alloy, finished to match flagpole.

B. Finial Eagle: Sized as standard with manufacturer for flagpole size indicated.

1. Cast aluminum, finished to match flagpole.
2. 20-oz. (0.70-mm) copper with 23-karat, gold-leaf finish.

C. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: Stainless-steel swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.
2. Plastic Halyard Flag Clips: Made from injection-molded, UV-stabilized, acetal resin (Delrin). Clips attach to flag and have two eyes for inserting both runs of halyards. Furnish two per halyard.

D. Internal Halyard, Cam Cleat System: 5/16-inch- (8-mm-) diameter, braided polypropylene halyard; cam cleat; and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

E. External Halyard: Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous 5/16-inch- (8-mm-) diameter, braided polypropylene halyard and 9-inch (228-mm) cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.

2.5 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

B. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

C. Sand: ASTM C 33/C 33M, fine aggregate.

D. Elastomeric Joint Sealant: complying with requirements in Section 079200 "Joint Sealants."

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.6 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

B. Clear Anodic Finish: AAMA 611

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.
D. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.

E. Sleeves: Locate and secure sleeves in forms by bracing to reinforcement and forms.

F. Anchor Bolts: Locate and secure anchor bolts in forms with templates and by tying to reinforcement.

G. Place concrete, as specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.

H. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.2 FLAGPOLE INSTALLATION

A. General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.

B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch (50-mm) layer of elastomeric joint sealant and cover with flashing collar.

C. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.

END OF SECTION 107516
SECTIO 114000 - FOODSERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Fabricated equipment.
   2. Food waste machines.
   3. Cooking equipment.
   4. Self-contained refrigeration equipment.
   5. Powered food-preparation equipment.
   6. Warewashing equipment.

B. Owner-Furnished Equipment: Where indicated, Owner will furnish equipment for installation by Contractor.

1.3 COORDINATION

A. Coordinate foodservice equipment layout and installation with other work, including layout and installation of lighting fixtures, HVAC equipment, and fire-suppression system components.

B. Coordinate locations and requirements of utility service connections.

C. Coordinate sizes, locations, and requirements of the following:
   1. Overhead equipment supports.
   2. Equipment bases.
   3. Floor depressions.
   4. Insulated floors.
   5. Floor areas with positive slopes to drains.
   6. Floor sinks and drains serving foodservice equipment.
   7. Roof curbs, equipment supports, and penetrations.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Santa Fe County Extension Office 3229 Rodeo Road Santa Fe NM, 87507.
1.5 ACTION SUBMITTALS

A. Product Data: For each type of product. Include the following:
   1. Manufacturer's model number.
   2. Accessories and components that will be included for Project.
   3. Clearance requirements for access and maintenance.
   4. Utility service connections for water, drainage, power, and fuel; include roughing-in dimensions.

B. Shop Drawings: For fabricated equipment. Include plans, elevations, sections, roughing-in dimensions, fabrication details, utility service requirements, and attachments to other work.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each factory-applied color finish required, in manufacturer's standard sizes.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For foodservice facilities.
   1. Indicate locations of foodservice equipment and connections to utilities.
   2. Key equipment using same designations as indicated on Drawings.
   3. Include plans and elevations; clearance requirements for equipment access and maintenance; details of equipment supports; and utility service characteristics.
   4. Include details of seismic bracing for equipment.

B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For foodservice equipment to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Product Schedule: For each foodservice equipment item, include the following:
         1) Designation indicated on Drawings.
         2) Manufacturer's name and model number.
         3) List of factory-authorized service agencies including addresses and telephone numbers.
1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with foodservice equipment by field measurements before fabrication. Indicate measurements on Coordination Drawings.

1.9 WARRANTY

A. Refrigeration Compressor Warranty: Manufacturer agrees to repair or replace compressors that fail in materials or workmanship within specified warranty period.

1. Failure includes, but is not limited to, inability to maintain set temperature.
2. Warranty Period: five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NSF Standards: Provide equipment that bears NSF Certification Mark or UL Classification Mark certifying compliance with applicable NSF standards.

B. BISSC Standards: Provide bakery equipment that complies with BISSC/Z50.2.

C. UL Certification: Provide electric and fuel-burning equipment and components that are evaluated by UL for fire, electric shock, and casualty hazards according to applicable safety standards, and that are UL certified for compliance and labeled for intended use.

D. Steam Equipment: Provide steam-generating and direct-steam heating equipment that is fabricated and labeled to comply with 2013 ASME Boiler and Pressure Vessel Code.

E. Regulatory Requirements: Install equipment to comply with the following:

3. NFPA 70, "National Electrical Code."


2.2 FABRICATED EQUIPMENT

A. Stainless-Steel Sinks
1. Description: three (3) compartment sink. Fabricate units of welded stainless steel, sound deadened.
   a. Bowls: Stainless steel, Type 304
b. Integral Drain boards: Stainless steel, Type 304

c. Body: Stainless steel,

1) Back Splash: Manufacturer's standard height
2) Side Splash: Manufacturer's standard height

d. Legs and Feet: Stainless-steel tubing legs with adjustable bullet feet.

e. Accessories:

1) Faucets and Spouts:
2) Prerinse Faucet:
3) Vacuum breaker.
4) Lever waste
5) Basket strainer.
6) Continuous waste.
7) Scrap trough.
8) Control bracket for food waste disposer controls.
9) Scrap block and hole.
10) Stainless-steel pot rack.

2. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
3. Fabrication: Prepare sink for installation of the following equipment items:

a. Commercial Food Waste Disposer

B. Stainless-Steel Tables:

1. Advance Tabco Stainless Steel Demo Table with Demo Mirror
2. Description: Demo table with mirror.

a. Tops: Stainless steel, Type 304

1) Back Splash: Manufacturer's standard height
2) Edge: Manufacturer's standard

C. Wire Shelving Units:

1. Metro Super Erecta Shelf or approved equal by Architect
2. Description: floor mounted with foot plates.
3. Finish: per Manufacturers’ standard

4. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, type as indicated.
5. Stainless-Steel Finish: Insert other types of fabricated equipment to suit Project.

2.3 FOOD WASTE MACHINES

A. Food Waste Disposer Units
1. Insinkerator Light Duty Model LC-50 or approved equal by Architect.
2. Description: 3 hp, with dual-direction shredding elements, and the following:
2.4 COOKING EQUIPMENT

A. Ranges

1. Garland GF Series 36"
2. Description: Model GF36-6R

   a. Top Configuration:
      1) Open-Burner Unit:
         a) Standard Burners: six

   b. Base Configuration:
      1) Standard Oven(s): One

c. Accessories:
   1) Stainless-steel back.
   2) Legs for curb base.

d. Gas Service: gas

B. Microwave Ovens

1. SOLWAVE Commercial Microwave
2. Description: 1000-W cooking power.

   a. Electrical Service: Equip unit with plug and cord for 120-V service.

2.5 SELF-CONTAINED REFRIGERATION EQUIPMENT

A. Refrigerators

1. TRUE Food Service Equipment Model TS-43 HC or approved equal by Architect
2. Description: Reach-in type.

   b. Interior Finish: Manufacturer's standard.
   c. Doors: Full length.
   d. Accessories:

      1) Casters.
      2) Stainless-steel back with rear louvers.
      3) Re-hinging feature for doors.
      4) Hinged glass doors and fluorescent fixtures.

   e. Electrical Service: Equip unit with plug and cord
B. Freezers

1. TRUE Food Service Equipment Model T-23F-HC or approved equal by Architect
2. Description: Compact unit with rear-mounted, self-contained refrigeration system.
   b. Interior Finish: Manufacturer's standard.
   c. Doors: Full length.
   d. Accessories:
      1) Casters.
      2) Stainless-steel back with rear louvers.
      3) Re-hinging feature for doors.
      4) Hinged glass doors and fluorescent fixtures.
   e. Electrical Service: Equip unit with plug and cord

2.6 MISCELLANEOUS MATERIALS

A. Installation Accessories, General: NSF certified for end-use application indicated.

B. Elastomeric Joint Sealant: ASTM C 920; silicone. Type S (single component), Grade NS (nonsag), Class 25, Use NT (nontraffic) related to exposure, and Use M, G, A, or O as applicable to joint substrates indicated.

   1. Public Health and Safety Requirements:
      a. Sealant is certified for compliance with NSF standards for end-use application indicated.
      b. Washed and cured sealant complies with the FDA's regulations for use in areas that come in contact with food.

   2. Cylindrical Sealant Backing: ASTM C 1330, Type C, closed-cell polyethylene, in diameter greater than joint width.

2.7 FINISHES

A. Stainless-Steel Finishes:

   1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
   2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
      a. Run grain of directional finishes with long dimension of each piece.
      b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
B. Powder-Coat Finishes: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install foodservice equipment level and plumb, according to manufacturer's written instructions.
   1. Connect equipment to utilities.
   2. Provide cutouts in equipment, neatly formed, where required to run service lines through equipment to make final connections.

B. Complete equipment assembly where field assembly is required.
   1. Provide closed butt and contact joints that do not require a filler.
   2. Grind field welds on stainless-steel equipment until smooth and polish to match adjacent finish.

C. Install equipment with access and maintenance clearances that comply with manufacturer's written installation instructions and with requirements of authorities having jurisdiction.

D. Install cabinets and similar equipment on bases in a bed of sealant.

E. Install closure-trim strips and similar items requiring fasteners in a bed of sealant.

F. Install joint sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Produce airtight, watertight, vermin-proof, sanitary joints.

3.2 CLEANING AND PROTECTING

A. After completing installation of equipment, repair damaged finishes.

B. Clean and adjust equipment as required to produce ready-for-use condition.

C. Protect equipment from damage during remainder of the construction period.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain foodservice equipment.

END OF SECTION 114000
SECTION 220000 - PLUMBING INDEX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
A. Furnish all service tools, equipment, etc., which are required for the complete installation of all Plumbing Work, as indicated on the Drawings and specified herein. Plumbing work indicated on the Drawings and/or specifications covering other trades shall conform to Division 22 of these Specifications.
B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Plumbing systems shall be accomplished without additional cost to the Owner.
C. Furnish all labor and materials required for plumbing service connections to all the various items of equipment requiring plumbing or piping throughout the project shown on the Contract Drawings (even if not shown on Plumbing Drawings). Coordinate with other trades for the installation of required connections and service.

1.3 PLUMBING DIVISION INDEX

220500 GENERAL PLUMBING REQUIREMENTS
220513 COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
220523 VALVES
220700 PIPING INSULATION
221000 PIPE AND PIPE FITTINGS
221113 DOMESTIC WATER SYSTEMS
221123 NATURAL GAS PIPING SYSTEMS
221313 SOIL AND WASTE PIPING SYSTEMS
224200 PLUMBING FIXTURES

PART 2 – PRODUCTS

PART 3 - EXECUTION

END OF SECTION 220000
SECTION 220500 - GENERAL PLUMBING REQUIREMENTS

PART 1- GENERAL

1.1 SUMMARY

A. Section Includes: General Plumbing Requirements specifically applicable to Division 22 sections in addition to Division 1- General Requirements.

B. Scope:
   1. The work covered by this division consists of performing all operations in connection with the installation of heating, cooling, ventilating, and plumbing including site utility work as indicated under this section. This entire section applies to all mechanical work and all mechanical sections of these specifications. This Contractor shall read and comply with all sections of these specifications including all General and Special Conditions.

1.2 REFERENCES

A. Standard Requirements:
   1. For products or workmanship specified by association, trades, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. All work shall be executed in accordance with the local and state codes, ordinances, and regulations governing the particular class of work involved. This Contractor shall be responsible for the final execution of the work under this heading to suit these requirements. In the event of a conflict between the various codes and standards, the more stringent shall govern. Where these specifications and accompanying drawings conflict with these requirements, the Contractor shall report the matter to the Architect/Engineer. The Architect/Engineer shall prepare any supplementary drawings required, illustrating how the work may be installed so as to comply. On approval of the change by the Architect/Engineer, the Contractor shall install the work in a satisfactory manner without additional cost to the Owner. On completion of the various parts of the work, the installation shall be tested by the constituted authorities and approved, and on completion of the work, this Contractor shall obtain and deliver to the Owner final certificates of acceptance. This Contractor shall furnish copies of each certificate to the Architect/Engineer.

C. The Contractor shall secure all permits and licenses for his work and shall pay all fees in connection with such permits and licenses.

D. The contractor shall hold and save the Owner free and harmless from liability of any nature or kind arising from his failure to comply with codes and ordinances.

E. Any and all meter deposits and all utility extension costs shall be paid by the Contractor whose work is done in connection with the service that the meter is connected to.

F. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

   1. AGA American Gas Association
      1515 Wilson Boulevard
      Arlington, VA  22209
   2. ANSI American National Standards Institute
3. **ASHRAE**
   American Society of Heating Refrigerating and Air Conditioning
   345 East 47th Street
   New York, NY 10017

4. **ASME**
   American Society of Mechanical Engineers
   345 East 45th Street
   New York, NY 10017

5. **ASPE**
   American Society of Plumbing Engineers
   960 Illuminating Building
   Cleveland, OH 44113

6. **ASTM**
   American Society for Testing and Materials
   1916 Race Street
   Philadelphia, PA 19103

7. **AWWA**
   American Water Works Association
   6666 West Quincy Avenue
   Denver, CO 80235

8. **AWS**
   American Welding Society
   2501 NW 7th Street
   Miami, FL 33125

9. **CISPI**
   Cast Iron Soil Pipe Institute
   1499 Chain Bridge Road
   McLean, VA 22101

10. **FM**
    Factory Mutual System
    1151 Boston-Providence Turnpike
    Norwood, MA 02062

11. **FS**
    Federal Specification
    General Services Administration
    Specifications and Consumer Information Distribution
    Section (WFSIS)
    Washington Navy Yard, Building 197
    Washington, DC 20407
G. Underwriters Laboratories Inc. (UL): All materials, appliances, equipment, devices or appurtenances shall conform to the applicable standards of Underwriters Laboratories Inc., where such standards have been established.

1.3 DRAWINGS

A. Drawings and specifications shall be considered as cooperative, and work or materials called for by one and not mentioned in the other, or vice versa, shall be done and furnished as though treated by both.

B. In the cases of discrepancies in figures, drawings, or specifications, the Architect/Engineer shall be notified immediately and his decision shall determine the necessary adjustment. Without such decision, said discrepancies shall not be adjusted by the Contractor save only at his
expense, and, in case of any settlement or any complication arising from such adjustment to the Contractor, he shall bear all extra expense involved.

C. Should it appear that the work intended to be done, or any of the matters relative thereto, are not sufficiently detailed or explained on the drawings or specifications, the Contractor shall apply to the Architect/Engineer for such further drawings or explanations as may be necessary, allowing a reasonable time for the Architect/Engineer to supply same, and the Contractor shall conform to same as part of the Contract.

D. Should any doubt or question arise in respect to the true meaning of the drawings or specifications, reference shall be made to the Architect/Engineer whose decision shall be final and conclusive. No alleged oral admission, condonation, or inadvertent neglect on the part of the Architect/Engineer will be accepted as an excuse for inferior work.

E. The mechanical plans do not give exact details as to elevations of ductwork and piping, exact locations, etc., and do not show all offsets, control lines, pilot lines, and other installation details. The Contractor shall carefully lay out his work at the site to conform to the structural conditions, provide proper grading of lines, to avoid all obstructions, to conform to details of installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated, satisfactory operational installation.

F. Should the particular equipment which any Bidder proposes to install, require other space conditions than those indicated on the drawings, the Bidder shall arrange for such space with the Architect/Engineer before submitting his bid. Should changes become necessary on account of failure to comply with these details, the Contractor shall make such necessary changes at his (the Contractor's own expense).

G. The Contractor shall submit working scale drawings of all his apparatus and equipment which in any way varies from these specifications and plans which shall be checked by the Architect/Engineer and approved before the work is started, Contractor before work proceeds. Interference with structural conditions shall be corrected by the Contractor.

H. All equipment shall be installed in accordance with the manufacturer's recommendations. Provide all accessories and components for optimum operation as recommended by the manufacturer.

I. Utilities: The location, size, and pressure of utility lines are shown in accordance with the data given this office by others. As Architect/Engineers, we cannot and do not guarantee the accuracy of this data. Each Bidder shall check and verify this data. The points of connection to utility lines are approximate only and shall be verified by each Bidder prior to submitting his Bid.

J. Site visit: The Contractor shall visit the site prior to bidding and satisfy himself as the conditions under which the mechanical systems are to be installed. No subsequent allowance shall be made in his behalf for failure to make such a visit. Contractor shall examine all work noted under the demolition drawings and all new work and shall satisfy himself as to the extent of work required to be completed.

1.4 SYSTEM DESCRIPTIONS

A. Not Used.

1.5 PRIOR APPROVALS

A. Each equipment item for which the Contractor desires to install equipment other than the specific item identified in the equipment schedule or equivalent equipment by manufacturers
specifically named in the schedule, the Contractor shall bear full responsibility to prove to the Engineer that the furnished equipment is equivalent to or better than the specified item. Failure to provide such proof will result in rejection of the shop drawing submittal by the Engineer. Prior written or verbal approval by the Engineer of equipment by other manufacturers will not relieve the Contractor of responsibility to provide equivalence. Prior approval is not required, however, any prior approval given is intended only to provide preliminary agreement that the alternate manufacturer may make equipment that complies with the specification requirements and not that all equipment manufactured by him is acceptable.

1.6 SHOP DRAWINGS

A. Shop drawings or fully descriptive catalog data shall be submitted by the Contractor for all items of material and equipment furnished and installed under this Contract. This shall include piping, ductwork, mechanical equipment, plumbing equipment, control items, etc. The Contractor shall submit to the Architect/Engineer a sufficient number of copies of all such shop drawings or catalog data to provide him with as many review copies as he may need, plus three (3) copies for retention by the Architect/Engineer. No materials or equipment shall be installed until officially approved by the Architect/Engineer.

B. Before submitting Shop Drawings to the Architect/Engineer for review, the Contractor shall examine them and satisfy himself that they are correctly representative of the material or equipment to which they pertain. The Contractor shall so note these Drawings before submitting them. The Contractor's review of Shop Drawings is not intended to take the place in any way of the official review of the Architect/Engineer, and the Shop Drawings which have not been reviewed by the Architect/Engineer shall not be used in fabrication or installing any work.

C. The review of Shop Drawings or catalog data by the Architect/Engineer shall not relieve the Contractor from responsibility for deviations from the plans and Specifications unless he has, in writing, specifically called attention to such deviations as the time of submission and has obtained the permission of the Architect/Engineer thereon, nor shall it relieve him from the responsibility for error of any kind in Shop Drawings. When the Contractor does call such deviations to the attention of the Architect/Engineer, he shall state in his letter whether or not such deviations involve any extra cost. If this is not mentioned, it will be assumed that no extra costs are involved for making the change.

D. After receiving approval on the make and type of materials, the Contractor shall order such materials in sufficient time so that no delay or changes will be caused. This is done to facilitate progress on the job and failure on the part of the Contractor shall render him liable to stand the expense of any and all delays occasioned by failure on this part to provide necessary details. All shop drawings shall be delivered to the Architect/Engineer's office within thirty (30) days from the date of the contract.

E. Shop drawings will be returned unchecked unless the following information is included: reference to all pertinent data in the Specifications or on the drawings, size and characteristics of the equipment, name of the project and a space large enough to accept an approval stamp. The data submitted shall reflect the actual equipment performance under the specified conditions and shall not be a copy of the scheduled data on the drawings.

1.7 SUBMITTALS

A. Submittal data shall be organized in commercial quality, three ring binders with durable and cleanable covers. Product information for each piece of equipment shall be separated by an indexing leaf with clear tabs. The product name and symbol (i.e. AHU/Air Handling Unit) shall be typed on white paper inserts and placed in appropriate tab. Complete data must be furnished
showing performance, quality and dimensions. A signed review by the Architect/Engineer must be obtained before purchasing any equipment.

B. The following items shall be submitted for review by the Architect/Engineer but are not limited to:

1. Pipe Insulation
2. Plumbing Fixtures and Trim
3. Cross Connection Control Devices
4. Pumps
5. Hydronic Air Control Devices
6. Plumbing Equipment
7. Heat Exchangers
8. Flexible Pipe Connections
9. Vibration Equipment and Calculations

1.8 QUALITY ASSURANCE

A. General: Comply with Division 1.

B. Welder Qualifications: Welders shall be certified by the American Society of Mechanical Engineers (ASME) National Certified Pipe for the type of work being performed. Current operators' certificates in accordance with ASME standards shall be on file at the site and shall be available to the Architect/Engineer for examination. Coupons shall be available for review by the Architect and Engineer.

C. Locations of all pipes, ducts, outlets, appliance, etc., as shown on the drawings, are approximate only and are understood to be subject to such revisions as may prove necessary or desirable at the time the work is installed. Each Contractor will be required to install his work with relation to existing building conditions and shall be entirely responsible for the correctness of his work with reference to finished elevations, etc. Piping shown on the drawings is diagrammatic only and their exact locations, depths, and invert elevations shall be as required for proper flow and coordination with other trades.

D. The contract drawing depicts graphically the arrangement of piping and ductwork. Should local conditions necessitate a rearrangement, or if any of the piping or ductwork can be installed to better advantage in a different manner, the Contractor shall, before proceeding with the work, prepare and submit three (3) copies of Drawings of the proposed arrangement for the Architect/Engineer's review.

E. If the Contractor proposes to install equipment, including piping and ductwork, requiring space conditions other than those shown, or to rearrange the equipment, he shall assume full responsibility for the rearrangement of the space and shall have the Architect/Engineer review the change before proceeding with the work. The request for such change shall be accompanied by Shop Drawings of the space in question.

F. Each Contractor is responsible for the proper location and size of all slots, holes, or openings in the building structure pertaining to his work, and for the correct location of pipe sleeves.

G. Each Contractor shall coordinate his work with that of all other trades that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades.
Piping interferences shall be handled by giving precedence to pipe lines which require a stated grade for proper operation. Drainage lines shall take precedence over water lines in determination of elevations. In all cases, lines requiring a stated grade for their proper operation shall have precedence over electrical conduit and ductwork.

H. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Lubricate all equipment properly in accordance with manufacturer's instructions. Furnish zerk grease fittings on all greaseable bearings.

I. Equipment and Materials: The materials and equipment shall be new and shall be the standard products of the manufacturers regularly engaged in the production of Plumbing, Heating, Cooling, Ventilation, and Fire Protection Equipment, and shall be the manufacturer's latest standard design. Where two or more units of the same class of equipment are required, these units shall be the products of the same manufacturer. However, the component parts of the systems need not be the products of the same manufacturer. Specific equipment specified hereinafter is to be considered a standard of quality and operation. In general, all capacities of equipment, and motor and starter characteristics are shown in schedules on the drawings. Reference shall be made to the schedules for specific information. The capacities shown are minimum capacities. Variations in the characteristics will be permitted only on written approval of the Architect/Engineer. All equipment shall be shipped to the job with not less than a prime coat of paint or as specified hereinafter. Insofar as is possible all items of the same type (i.e., pumps, fans, etc.) shall be by the same manufacturer. Where installation instructions are not included in these specifications or on the plans, the manufacturer's instructions shall be followed. All equipment affected by altitude shall be rated to operate at the altitude where it is to be installed.

J. Excavation and Backfilling: This Contractor shall do all necessary excavation and backfill for the installation of the Mechanical systems as may be required. Curb cuts, asphalt and concrete patching, cutting and patching existing floor, etc., shall be part of this Contractor's responsibility. No extra payment will be made for rock excavation. Trenches for all underground piping shall be excavated to the required depths. The bottoms of trenches shall be tamped hard and graded to secure maximum fall. Bell holes shall be excavated to assure the pipe resting for its entire length on solid ground. Should rock be encountered, it shall be excavated to a depth of 6 inches below the bottom of the pipe, and before laying the pipe, the space between the bottom of the pipe and the rock surface shall be filled with gravel, thoroughly tamped. Pipe laid in trenches dug in fill shall be supported down in the trenches and shall be filled. No roots, rocks or foreign materials of any description shall be used in backfilling the trenches. The backfill material shall be identical to the surrounding fill material and shall be placed in 6-inch layer, wetted, and compacted to the density of the adjacent soil. See Division 2 for additional information for site utilities. All surplus materials shall be hauled from the project by the Contractor at his expense.

K. Cutting and Repairing:

1. Responsibility of the Contractor whose work is involved. Coordinate with others to prevent unnecessary cutting and repairing.

2. Lay out and locate equipment, openings, and chases. Install sleeves, inserts, and supports. Arrange with those whose work is involved to do cutting and replacing caused by negligence or error with costs reimbursed by the Contractor at fault. Cutting and replacing of existing work shall be the responsibility of the Contractor whose work is being installed.
GENERAL PLUMBING REQUIREMENTS

3. Removal or terminating connections of existing work which is abandoned or replaced shall also be done hereunder to provide correct and finished work.

L. Foundations: All equipment shall be provided with suitable foundations and supports. It shall be the responsibility of the Contractor to provide for the proper locations of these foundations and supports. This applies to all rooftop equipment also.

1. All concrete foundations required by equipment furnished by the Mechanical Contractor shall be constructed by them (except where otherwise noted) the conformity with the recommendations of the manufacturer of the respective equipment, and with the approval of the Architect/Engineer. All corners of the foundations shall be neatly chamfered. Foundation bolts shall be placed in the forms when the concrete is poured. Allow 1 inch below the equipment base for alignment, leveling and grouting with nonshrinking grout. Grouting shall be done after the equipment is leveled in place. After the grout has hardened, the foundation bolts shall be pulled up tight and the equipment shimmed, if necessary. After removal of the forms, the surface of the foundation shall be rubbed.

2. Unless otherwise noted, foundations shall be a minimum of 6-inch high. All concrete work performed by these Contractors shall conform entirely to the requirements of the Concrete Specifications which describe this class of work.

M. Code Requirements: Comply with state and local code requirements and ordinances. Call for inspections required by responsible building inspection authority.

N. Applicable Building Codes and Ordinances: Including the latest edition of each code, but not limited to the following:

2. Uniform Mechanical Code.
4. Governing Fire Department Requirements
5. Utility Company Requirements
6. National Fire Protection Association Standards
7. NFPA 70 - National Electrical Code
8. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
9. NEPA 90B - Installation of Warm Air Heating and Air Conditioning Systems
10. NFPA 13 - Sprinkler Systems
11. NFPA 101 - Life Safety
12. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment

O. ACCESS PANELS

1. Similar to Milcor, or as noted on the drawings, size as required for concealed expansion joints, valving, gauges, balancing dampers, valves, traps, pitot stations, equipment and similar items requiring accessibility. Notify the General Contractor of each access panel location and the required size. Panels shall be proper type for ceiling or wall in which they are installed. The panels shall be furnished under this section of the Specifications,
unless otherwise directed, but shall be coordinated to be compatible with walls and ceilings furnished under other sections.

1.9 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 1.

B. Large Items: Make arrangements with other trades on the job for introduction into the building of equipment too large to pass through finished openings.

C. Acceptance: Check and sign for materials to be furnished by others for installation under Division 22 upon delivery. Contractor shall be responsible for the storage and safekeeping of such materials from time of delivery until final acceptance.

D. Protection: Close ends of pipe at the close of each working day during construction to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Protect fixtures and equipment against damage during mechanical work with heavy paper or plastic until final clean-up.

E. Storage: Store equipment in covered enclosure or wrap with weather tight 6 mil Visqueen.

F. Shipping Protection: Protective casings, crating, and coverings to remain in place until start-up of equipment.

1.10 PROJECT CONDITIONS

A. Performance: All systems are to be rated at 4,500 ft. elevation.

1.11 SEQUENCING AND SCHEDULING

A. General: Comply with Division 1.

B. Schedule: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.

C. Utility Interruptions: Schedule mechanical utility interruptions with the Architect/Engineer/Owner minimum of seven (7) days prior to the requested outage. Plan work so that duration of the interruptions a maximum of one day.

1.12 CONTROLS WIRING AND ELECTRICAL EQUIPMENT

A. All mechanical equipment controls wiring, conduit, relays, interlocks, and all accessories required for a completely operational controls system shall be the complete responsibility of the mechanical contractor. The mechanical contractor has the option to hire the project electrical contractor or any qualified controls contractor to install mechanical controls wiring and conduit. Refer to Specification Section 253000 for coordination requirements between mechanical, electrical, and controls subcontractors.

B. Electrical items such as disconnect switches and motor starters associated with equipment provided by Division 22, when specifically mentioned to be furnished by the Mechanical Contractor, whether in these specifications or on the Electrical or Mechanical Drawings, shall be furnished by the Contractor. These items shall be mounted and connected as required for a completely operational system. See Control Systems Specification for further information.

C. All electrical equipment characteristics (voltage, etc.) must be verified by the Contractor prior to ordering. If the Contractor proposes to furnish motors varying in horsepower and/or characteristics from those specified, he shall first inform the Architect/Engineer of the change.
and shall then coordinate the change with the Electrical Contractor and shall pay all additional charges in connection with the change.

D. All motors shall meet all the requirements of all Electrical Divisions.

1. All motors shall be built in accordance with the current applicable IEEE, ASA, and NEMA standards. All general purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations. Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. All motors shall have copper windings. All motors to have minimum power factor of 85% or have switched correction to 90%. Unless indicated otherwise, motors shall be NEMA design B with a service factor of 1.15 with 40°C rise and total temperature rise of 65°C ambient and when powered from the system voltage feeding the motor. TEFC motors shall a service factor of 1.00 with total temperature of 65°C in the above conditions. Motors located in areas exceeding 40°C ambient shall be factory-rated for the ambient temperature of the motor environment. Single phase motors shall generally be NEMA Type N split phase induction motors with built-in thermal protectors. Single phase motors connected on loads requiring high starting torque shall be capacitor-start induction motors. Single phase motors of 1/10 HP or less may be shaded pole induction motors.

1.13 PROTECTION AGAINST HAZARDOUS CONDITIONS

A. The Contractor shall take precautions against hazardous construction conditions at all times during construction. The final condition of the facilities shall be safe, and where safety to operating personnel is jeopardized, suitable signage shall be posted.

B. Protruding metal (bolts, steel angles, etc.) potentially hazardous to maintenance and operating personnel, shall be cut back and/or protected to reduce the risk of injury. All openings between floors shall be protected with barriers around the openings, gratings across the openings, or steel bars through the openings to avoid and protect against injury.

1.14 HAZARDOUS SIGNS

A. Equipment room contains moving or rotating parts, floor openings, or other potentially hazardous environments and shall include a sign on the door entering it that shall read similar to the following: Hazardous Area - Authorized Personnel Only.

1.15 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Mechanical Contractor shall furnish to the Owner a bound (three (3) ring binder) manual in triplicate, containing complete repair parts lists, and operating, service, and maintenance instructions on all mechanical equipment, fixtures, and systems, as noted below:

1. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect/Engineer, Sub-consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

2. For Each Product System: List names, addresses and telephone numbers of Sub-contractors and suppliers, including local source of supplies and replacement parts.

3. Product Data: Mark each sheet to clearly identify specific product and component parts, and data applicable to installation. Delete inapplicable information.

4. Warranties and Bonds: Bind in copy of each.
5. 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.

6. Include color-coded wiring diagrams as installed for control system.

7. Operating Procedures: Include start-up, break-in and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.

8. Maintenance Requirements: Include routine procedures and guide for trouble-shooting, disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

9. Provide servicing and lubrication schedule and list of lubricants required.

10. Include manufacturer’s printed operation and maintenance instructions.

11. Include sequence of operation by controls manufacturer.

12. Provide original manufacturer’s part list, illustrations, assembly drawings and diagrams required for maintenance.

13. Provide control diagrams by controls manufacturer as installed.

14. Provide charts of valve tag numbers, with locations and functions of each valve, keyed to flow and control diagrams.

15. Provide list of original manufacturer’s spare parts and recommended quantities and to be maintained in storage.

16. Include Test and Balance (T&B) Reports as specified in Section 230593.

B. The Mechanical Contractor shall also provide training as required by Section 230100 to the Owner’s operation and maintenance personnel.

1.16 OPERATION PRIOR TO ACCEPTANCE

A. The Owner shall have the right to operate any and all apparatus as soon as and as long as it is in operating condition, after Owner personnel have received operational training, whether or not such apparatus has been accepted as complete and satisfactory, except that this shall not be construed to mean operations before any required alterations or repairs have been made. This operation does not indicate acceptance of the equipment by the Owner. When the Contractor enters into a contract with the Owner, he agrees to the above.

1.17 WARRANTY AND SERVICE PROGRAM

A. Due to the critical performance requirements and to clearly establish warranty responsibility for this project, the Contractor shall provide a full service maintenance and warranty program to the Owner for one full year after beneficial occupancy (substantial completion).

B. This service program shall be included as part of the base bid and shall include service, maintenance, repair, replacement, lubrication, temperature control calibration and repairs, and documenting proof for all service and maintenance work on all equipment and system furnished by the Contractor.

C. A single representative in the employment of the Contractor shall be responsible for coordination and follow through of this program. This representative's name and phone number
shall be submitted to the Owner as part of the maintenance manuals and supportive data. The Contractor shall respond to a request for service with 24 hours if so requested.

D. During this first year of operation, the following sequence of maintenance service shall be performed as a minimum.

1. Clean strainers in piping.
2. Fans and/or pumps be lubricated and oiled once every four (4) months.
3. Controls shall be calibrated throughout the facility at the end of six (6) months (following substantial completion). Any leaks in the piping systems shall be repaired.
4. All equipment manufacturers’ service recommendations shall be followed during this period.

1.18 FLUSHING AND DRAINING

A. It shall be the responsibility of this Contractor to properly drain and flush all ducts and pipes before use or acceptance to ensure that all debris is completely removed. Damage caused by such debris remaining in the ducts or pipes shall be repaired by this Contractor at his expense. This Contractor shall demonstrate to the Architect/Engineer's representative that all piping is clean.

1.19 CLEANING

A. This Contractor shall remove from the building construction site all rubbish and dirt as it accumulates under the contract. At completion, all areas shall be broom cleaned and all obstructions, surplus materials, etc., removed.

1.20 GUARANTEE

A. The Contractor shall guarantee all materials, equipment, and workmanship furnished and installed by him under this Contract, to be free from all defects of workmanship and materials, and shall agree to replace at his expense, without expense to the Owner, at any time within one year after installation is accepted by the Architect/Engineer, any and all defective equipment, parts, etc., that may be found. (This excludes normal maintenance and daily servicing of equipment which is the Owner's responsibility.)

1.21 FLOOR, WALL, AND CEILING PLATES

A. Where exposed pipes pass through floors, finished walls, or finished ceiling, they shall be fitted with chromium-plated escutcheons of an approved pattern. Escutcheons and plates in Mechanical Rooms do not require chrome finish.

B. This Contractor shall be responsible for providing and installing all counter flashing. All openings in the roof shall be flashed and counterflashed. Use four pound lead flashing materials for all vent lines and welded flashing in steel lines passing through roof. The Mechanical Contractor shall notify the General Contractor where each roof penetrations are and the size of the opening.

1.22 PIPE SLEEVES

A. Schedule 40 steel pipe sleeves or pipe sleeves made of No. 20 gauge galvanized steel, properly secured in place with approximately 1/4" space between each sleeve and the surface of the pipe and/or insulation passing through it, shall be provided for all pipes passing through concrete floors, roofs, and masonry walls. All pipe sleeves shall be fixed in place as the walls and floors are built up. The Contractor shall furnish and locate all sleeves and pipes passing through
concrete floors, exterior masonry walls, and roofs shall be made watertight with approved non-
hardening plastic material. Sleeves through pipe chase or equipment room floors shall project a
minimum of 2-inch above the floor and shall be of black steel pipe with waterproof flange at
center of floor thickness. Each sleeve through a fireproof wall shall be packed with approved
fireproof rope in the annular space.

1.23 PIPE HANGERS

A. Pipe hangers shall be Fee and Mason of a type suitable for each use. Perforated straps shall not
be used in any work. For ferrous pipes up to and including 4 inch in size, use Fee and Mason
Fig. 199 malleable iron, adjustable, split ring, swivel hanger. For plumbing piping larger than 4
inch, use Fee and Mason Fig 239 steel clevis hanger. Where several pipes are parallel at the
same elevation, trapeze hangers may be used. Where trapeze hangers are used, the pipes shall be
supported on rollers where indicated on the Drawings. For copper pipes up to and including 3
inch in size, use Fee and Mason Fig. 360 malleable iron, copper plated hangers. For copper
pipes larger than 3 inch, use Fee and Mason Fig. 364 copper plated clevis hanger.

B. Hanger rod sizes shall conform to the following schedule:
   1. Pipe up to and including 2" 3/8" rods
   2. Pipe 2-1/2", 3" and 3-1/2" 1/2" rods
   3. Pipe 4" and 5" 5/8" rods

C. Unless shown otherwise on the Plans, all horizontal runs of ferrous piping shall be suspended
from the floor or roof construction, as the case may be, by means of hangers with the following
spacing:
   1. Pipe up to and including 1-1/4" 8'
   2. Pipe 1-1/2" and 2" 10'
   3. Pipe 2-1/2" and 3" 12'
   4. Pipe 3 1/2" and 4" 14'

D. Unless shown otherwise on the Plans, all horizontal runs of copper piping shall be suspended
from the floor or roof construction as the case may be, by means of hangers with the following
maximum spacing:
   1. Pipe up to 3/4" in size 5'
   2. Pipe 1" and 1-1/4" 6'
   3. Pipe 1-1/2" and larger 10'

E. There shall be a hanger within 2 inch of each elbow or tee. Additional supports shall be
provided for valves, strainers, etc. Cast iron pipe shall have not less than one hanger per length
of pipe. Vertical risers shall be supported by approved riser clamps at each floor. Vertical pipes
within a space shall have not less than two supports.

F. Supports and hangers shall be installed to permit free expansion and contraction in the piping
systems. Hangers shall permit vertical adjustment to maintain proper pitch. Where necessary to
control expansion and contraction, the piping shall be guided and firmly anchored. No piping
shall be self-supporting, nor shall it be supported from equipment connection.

G. Expansion bolts shall be Ackerman-Johnson or Hilti.
H. Beam clamps suitable for use with this type of steel construction involved shall be Grinnell.

1.24 PRESSURE VESSEL CERTIFICATION

A. Not used.

1.25 ISOLATION

A. Excessive vibration or objectionable noise created in any part of the building by the operation of any equipment furnished and/or installed under the Mechanical Contract will be extremely objectionable and the Contractor shall take all precautions against the same by isolating the various items of equipment from the building structure and by such other means as may be necessary to eliminate all excessive vibration and objectionable noise produced by any equipment installed by them, and consequently, they shall design all foundations, supports, etc., for their equipment, and all piping with this end in view. In addition, these Contractors shall supervises the construction of all foundations and supports, whether they build them or not, in order that they may be constructed in such a manner as to prevent the transmission of objectionable noise and/or excessive vibration. Submit calculations on all vibration isolation equipment.

B. All equipment having moving parts shall be isolated from the building structure by means of Korfund isolation materials, unless specifically noted otherwise. All isolators shall be the same brand and shall be supplied from the same source. Equipment manufacturer's recommendations shall be followed in the isolation of equipment.

C. Vibration isolators shall have sufficient resilience to meet the following minimum efficiencies:

<table>
<thead>
<tr>
<th>Motor HP</th>
<th>Equipment Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5</td>
<td>90%</td>
</tr>
<tr>
<td>7-1/2 to 15</td>
<td>93%</td>
</tr>
<tr>
<td>20 to 40</td>
<td>95%</td>
</tr>
<tr>
<td>50 to 100</td>
<td>97.5%</td>
</tr>
</tbody>
</table>

D. Spring isolators shall be of the housed type with ribbed pads bonded to the underside of the baseplate, or may be unhoused stable springs. Isolators shall be furnished with snubbers and limit stops where so recommended by the equipment manufacturer.

E. The Supplier of the isolating equipment shall, upon completion of the job, check all isolating materials and verify that they are installed properly, and submit a report in writing to the Architect/Engineer.

1.26 TESTING

A. Before completion of this project, the Mechanical Contractor shall test all materials and equipment which normally require testing. All piping, etc., shall be tested to meet code requirements or the Specification requirements, whichever is more stringent.

B. All equipment shall be operated sufficiently long enough to prove to the Architect/Engineer that the equipment performs satisfactorily and meets the requirements set forth on the Plans or in these Specifications.
1.27 CERTIFICATIONS
A. Before receiving final payment, the contractor shall verify that all equipment furnished and all work done is in compliance with all applicable codes mentioned in these Specifications. Submit certifications and acceptable certificates to the Architect/Engineer.

1.28 GENERAL PIPING INSTALLATION REQUIREMENTS
A. Provisions for Drainage: All piping systems shall be installed so that they may be easily drained. Drain caps, plugs, or hose bibbs shall be installed at low points. Grade piping toward drain locations.
B. Alignment: All installed pipe lines shall be straight and shall remain straight against strains. Proper allowance shall be made for expansion and contraction.
C. Clean as Installed: All piping shall be kept free from scale or loose dirt when installed, and must be kept clean during the completion of the installation. All openings in the piping system shall be capped or plugged while awaiting further connections. All detergents, solvents and other cleaning agents shall be compatible with the materials of fabrication of the system in which they are used. They shall not adversely affect the materials of mechanisms in the systems and they shall be acceptable to equipment manufacturers. All detergents, solvents, and other cleaning agents shall also be compatible with the process streams to be handled by the systems in which they are used.
D. Insulated Fittings: Install between any dissimilar metals such as steel and copper.
E. Expansion and Contraction: The Contractor shall make all necessary provisions for expansion and contraction with proper fittings, anchors, dresser couplings, loops, etc. Install flexible connectors on each pipe at each building expansion joint.
F. Welding: Refer to Paragraph 1.29 of this section of these specifications.
G. Bending: No bending of pipe will be permitted.
H. General: The installation shall be coordinated with respect to space available with heating, cooling, ventilating, and electrical installation. In every instance where there is a conflict in the routing of the piping and the ducting, the routing of the ducting shall govern. Installed piping shall not interfere with the operation or accessibility of doors or windows, shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Cutting or weakening of structural members to facilitate piping, installation is not permitted. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping above ground shall be run parallel with the lines of the building unless otherwise noted on the drawings. Unless otherwise shown on the drawings, horizontal piping shall pitch down in the direction of flow with grade of not less than 1 inch in 40 feet. Piping connections to equipment shall be in accordance with details shown on the drawings or as recommended by the equipment manufacturer. Service pipe valves and fittings shall be kept a sufficient distance from other work to permit finished covering not less than 1/2 inch from such other work, and not less than 1/2 inch between finished covering on the different services.
I. Installation of Valves: Valves shall be installed at the locations shown on the drawings and where specified and where directed at site. Gate valves shall be used unless otherwise shown,
specified, or directed. All valves shall be installed with their stems horizontal or above. Where tight shut-off is required, a composition seat globe valve or resilient seat ball valve shall be used.

J. All valves which must be used during operation, all control valve assemblies, instrument control cases, liquid level controls, gage glasses, orifices, relief valves, and other equipment which must be observed, adjusted, or serviced during operation shall be located conveniently accessible from an operating platform or grade.

K. In general, relief valves within processing unit limits shall be located conveniently accessible from an operating platform or grade.

1. Those in non-hazardous service, such as water, shall discharge directly to outside.

2. Relief valves should have no piping between the vessel or line and the valve inlet, except as shown on the drawings.

3. Relief valves shall be installed in a vertical position. Vent piping shall be braced and supported in a manner that will not produce excessive stresses in the relief valve and will permit removal of the relief valve without necessary temporary supports for the vent lines.

L. Equipment Connections: All piping connections to pumps and other equipment shall be installed without strain at the pipe connection of the equipment. The contractor shall be required as directed to remove the bolts in flanged connections or disconnect piping to demonstrate that the piping has been so connected. Pipe connections to equipment shall be made with unions or flanged fittings. Provide removable headers for large equipment for service access.

M. Joints

1. Flanged Joints: All flanged joints shall be face matched. Raised face flanges shall not be mated to flat-faced cast-iron flanges on valves or equipment. The raised face must be turned off. All flanged bolt holes shall straddle the horizontal and vertical center line unless otherwise noted.

2. Screwed Joints: Screwed pipe joints shall have American Standard Taper Pipe Threads ANSI-B2.1 Latest Edition. Burrs formed when cutting pipe shall be removed by reaming. Care shall be taken that the inside of pipe is thoroughly clean and free of cutting oil and foreign matter before installation. Joints shall be made perfectly tight by the use of Teflon tape or approved Teflon thread sealing and lubricating compound.

3. Solder-Joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool or wire brush before seating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections. Joints for serrated fittings on water, compressed air below 60 psig, and vacuum lines shall be made with a 95 percent tin and 5 percent antimony. Cored solder or solder containing lead will not be permitted.

N.Reducers: Reduction in pipe size shall be made with one piece reducing fittings. Bushings reducing at least two pipe sizes will be acceptable only when there is no room for reducing couplings or swaged nipples.

O. Unions: All piping unions shall be of the ground joint type constructed from materials equivalent in alloy composition and strength to other fittings specified with which they are used. Union Pressure classes and end connections shall be the same as the fittings used in the lines with the unions. Steel unions shall have hardened stainless steel seating surfaces on both faces.

P. Hanger Supports:
1. All hanger rods used to support piping, conduit, mechanical units, equipment, trapezes and other items shall be straight and installed plumb, regardless of length. Do not bend rods to adapt to sloped or rotated structural members, secondary support members or to sloped mounting holes on supported equipment. Contractor shall utilize available swivel, hinged, or rigid mounting techniques designed to accommodate a slope or rotation, or shall design a custom solution. Selected techniques for each application shall be submitted for approval prior to use.

2. Do not bend rods to circumvent an obstruction.

3. Loads on hanger rods shall be applied in direct tension. Do not apply compression, lateral or moment loads to hanger rods. Install bracing or additional supports to prevent hanger rod from incurring non-tension loading.

4. Do not create offsets in rods; use only in-line couplers, and only when length of coupled rod exceeds standard available length (typically 12 feet), or when full lengths cannot be placed in position. Provide additional horizontal bracing to prevent swaying of supported piping or equipment.

5. Do not straighten bent rods for subsequent use. If a rod becomes bent, cut off and discard the bent portion. Remaining straight portion of rod may be used.

1.29 WELDING

A. All welding of piping covered by this specification, regardless of condition of service shall be accompanied as follows:

1. The welding shall be in accordance with the recommendations of the American Welding Society. Mitering of pipe to form elbows, notching to form these, or any similar construction will not be permitted. Welding fittings shall be installed on all welded lines. Joints to be welded shall be properly aligned and spaced, using special welding clamps where necessary. All welders to be employed shall have passed qualification tests prescribed by the National Certified Pipe Welding bureau (or by another reputable testing laboratory or agency) using procedures approved by the American Society of Mechanical Engineers or the American Welding Society. The welders will be required to pass qualification tests when the work of the welder creates a reasonable doubt as to his proficiency. Tests shall be conducted at no additional expense to the Owner.

2. Each welder shall, in addition to having passed the prescribed qualification tests (as noted in Paragraph 1.30.A.1), prepare sample coupons at the job site on a portion of pipe that is cut such that the cross section of the weld is open to view. The sample weld should be prepared using a 6 inch diameter pipe. The sample shall reflect a continuous weld with perpendicular cut out to show the weld in cross sectional view. This sample, when accepted and approved by a certified welding inspector, shall be used as a standard of quality to compare to other welds that this welder will be performing on the job. This same sample weld will also be a basis for accepting or rejecting the welder for working on this project. The sample weld shall be identified with a date and the welder's name and shall be kept at the site throughout the project.

3. All welding on pressure piping shall conform to all of the requirements of the American Society of Mechanical Engineers Code for Pressure Piping - B31.1 (An American National Standards Institute publication), as defined in the latest edition of the ANSI Power Piping B31.1 Manual. All welding shall also conform to all of the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code.
chapters, current addenda and supplements of these manuals shall apply. This code shall be used to establish standards of performance and quality of welds. However, the Owner reserves the right to perform radiographic testing of all welds, to compare any of the welds to the approved "standard" sample welds of each welder, and to compare the welds to the welding diagrams and sketches of those recommended in the ANSI B31.1 Power Piping Manual. The intent is to obtain the highest quality welding job possible. The cost of any initial radiographic testing, for random inspection, shall be paid for by the Owner. If radiographic random testing reveals that a weld is defective, the Contractor shall bear the cost of all repairs and re-testing necessary to be made to subject weld until conformance with radiographic tests is reached. The potential for random radiographic testing and welding quality control applies to all pressure piping systems in this project, including systems below 100 psig. If a question should arise regarding the possibility of faulty welding or if there are obvious visual defects in the welding, the Contractor shall be required to correct such deficiencies to a quality level consistent with the recommendations, welding diagrams and sketches in the ANSI B31.1 Manual. The quality level shall also reflect that of the approved sample welds accomplished by each welder for this particular project.

1.30 TESTING FOR PIPING SYSTEMS

A. General: Before insulation is applied, all piping, equipment, and accessories installed under this contract shall be inspected and tested by the Contractor. All labor, material, and equipment required for testing shall be furnished by the Contractor. The Contractor shall be responsible for all repairs and retesting as required. All instruments and other equipment whose safe pressure range is below that of the test pressure shall be removed from the line or blanked off before applying tests. Prior to performing tests, all lines shall be "blown" free of all loose dirt and foreign particles. The lines shall then be thoroughly flushed with water (liquid lines only) at a sufficient flow rate and period of time, to ensure complete cleaning of the lines of all dirt, scale, and foreign matter. Satisfactory flushing of the lines shall be subject to approval. After testing and flushing lines, all filters and strainers shall be cleaned.

B. Safety: Since the Risk of failure, with the attendant possibility of injury, is appreciable greater with further testing, all safety measures required by codes or ordinance or reasonable applicable to the situation shall be taken.

C. Concealment: Equipment or piping to be pressure tested shall not be insulated, covered, or concealed prior to that test. Compression joint underground piping may be backfilled prior to pressure test except that joints shall remain exposed until after the test, but tie rods, clamps, etc., shall be in place and fastened.

D. Pressure Ratings: These tests shall not be used to establish pressure ratings.

E. System Protection: Protect all piping and equipment against overpressure, collapse from vacuum, and hydraulic shock during the filling, testing and draining procedures. Seats of iron valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Pressure tests against other closed valves shall not exceed twice the normal rating. Note that where significant differences in elevation exists, there is a risk of overpressure in the lower portions of the system in order to attain test pressure in the upper portion of the system.

F. Test Temperature: Apply test pressure only after the system and test medium are at approximately the same temperature, preferably not less than 60°F. Note that some applicable codes require testing above a specified minimum temperature.
G. Sectionalizing: Systems may be separated into sub-systems for testing if such action will expedite or simplify the testing.

H. Temporary Supports: During hydrostatic testing of lines provide temporary supports to prevent overstressing supports or hangers. When tests are completed, remove all temporary supports, locks, stops, etc., and adjust supports for their cold load and alignment.

I. Testing: Domestic hot and cold water piping and heating water piping shall be tested hydrostatically at the test pressures specified and shall show no drop in pressure in a 2 hour period. Leaks shall be located by soap testing

   1. Test Pressures:
      a) Natural gas piping: as required by governing code
      b) Domestic Hot and Cold Water: 100 psig or 50% more than operating pressure, which ever is greater.

J. Sanitary Waste and Soil System:

   1. After all soil and waste pipes and vent stacks have been installed, the outlets shall be plugged and the piping system filled with water in vertical sections to the highest point of the system and allowed to remain filled for twenty-four (24) hours and shall prove to be leaktight under such conditions. A one inch drop will be allowed in water level in standpipe. This test may be conducted in segments as required by the sequence of construction. Contractor shall certify in writing that all tests were satisfactorily completed before piping was concealed, and shall submit the certification to the Architect/Engineer for his records and for transmittal to the owner.

K. Test Report

   1. A detailed report of pressure tests on piping and equipment shall be forwarded in duplicate to the Architect/Engineer. This report shall show date of test, lines tested, test medium, length of time test pressure was held, pressure drop or rise, and extent of venting or repressurizing.

1.31 COOPERATION WITH OTHER TRADES

A. The Contractor shall refer to other sections of these specifications covering the work of other trades which must be carried out in conjunction with the mechanical work so that the construction operations can proceed without harm to the Owner from interference, delay or absence of coordination.

1.32 FIELD MEASUREMENTS

A. The Contractor shall verify the dimensions covering the mechanical work at the building. No extra compensation shall be claimed or allowed on account of difference between actual dimensions and those indicated on the drawings. He shall examine the adjoining work on which Mechanical work is dependent for maximum efficiency, and shall report any work which must be corrected. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable work conditions affecting Mechanical work.

1.33 SAFETY GUARDS

A. The Mechanical Contractor shall furnish and install safety guards required in order to obtain certificates of inspection from all authorities having jurisdiction. All belt driven equipment,
projecting shafts, and other rotating parts shall be enclosed or adequately guarded. Provide coupling guards on all rotating shafts.

1.34 PROTECTION

A. All work, equipment, and materials shall be protected at all times to prevent obstruction, damage, or breakage. All pipe openings shall be closed with caps or plugs during installation. All equipment shall be covered and protected against dirt, water, chemical, or mechanical injury. At the completion of the work, all equipment shall be thoroughly cleaned and the entire system shall be delivered in a perfect, unblemished condition.

1.35 PAINTING AND IDENTIFICATION

A. All equipment shall be delivered to the job with suitable factory finish. Should the finish be marred in transit or during installation, it shall be finished to present a neat, workmanlike appearance.

B. Except as elsewhere hereinafter specifically required, any painting of equipment, piping, ductwork, grilles, insulation, etc., furnished and installed under this Section of the Specifications will be done by the Painting Contractor. However, the Mechanical Contractor shall leave his equipment clean and free from any grease, dirt, rust, etc., and in suitable condition for painting.

C. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent there being rendered illegible during the painting operation.

D. The piping shall be painted the basic color as indicated in other sections of these specifications and shall be marked every 10 feet on centers with Brady pipe markers. Arrows, approximately 6 inch in length and spaced about 10 feet on centers shall indicate the direction of the flow pipe. Locate additional labels as required in Mechanical Rooms. Staple in place, brush with clear lacquer. Markers shall state pipe size, flow direction, and pipe usage (such as "cold water," etc.).

1.36 RECORD DRAWINGS

A. The Contractor shall, during the execution of the work, maintain a complete set of drawings upon which all dimensional locations of equipment piping and all deviations and/or changes in the work shall be recorded. Water, storm, and drainage mains shall be delivered to the Architect/Engineer in good condition upon the completion and acceptance of the work and before final payment is made.

1.37 SUPPLIER RESPONSIBILITY

A. Each supplier, whether furnishing equipment as specified or as a substitution shall be responsible for certifying that the equipment is properly installed and that the warranty is valid. Submit written reports on the installation and the equipment performance when requested to do so by the Architect/Engineer (or his representative). Each supplier shall be responsible for furnishing qualified personnel at the job site at anytime requested by the Architect/Engineer (or his representative) during the construction or warranty periods.

END OF SECTION 220500
SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
A. It is the intent of this specification to define all motors furnished under all sections of the specifications for this project which will provide efficient operation, reliability, ease of maintenance, and repair along with reduced operation costs.
B. All general purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations. Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. Motors shall be rated explosion-proof when located in hazardous atmospheres.
C. Motors mounted in direct sun shall be provided with a shield to forbid direct radiation from the sun when the sun is 45 degree or greater above the horizon.
D. All supply fan motors mounted in air handling units shall have Class F insulation.
E. Open drip-proof motors shall be NEMA design B with Class B insulation and a 1.15 service factor with 40 degree C ambient and a total temperature rise of 65 degree C.
F. TEFC motors shall be NEMA design B with Class F insulation and a 1.15 service factor with 40 degree C ambient and a total temperature rise of 65 degree C.
G. Severe duty motors shall be NEMA design B with Class F insulation and a 1.15 service factor with 40 degree C ambient and a total temperature rise of 65 degree C.

1.3 GENERAL
A. All motors covered by this specification shall conform to all applicable requirements of NEMA, IEEE, ANSI and NEC Standards. They shall be free from defective material and workmanship and fully capable of performing in accordance with the manufacturer's nameplate rating.
B. Motors shall be approved by Underwriter's Laboratories (UL) for the service specified.
C. Unless otherwise specified, motors shall be suitable for operation in either direction—(CW or CCW) or rotation.
D. Motors shall be Westinghouse II, Reliance XE, Gould E-PLUS, GE Energy Savery, or approved equal.
E. All fractional H.P. motors shall be permanent split capacitor (P.S.C.) with U.L. listed overload protection. The protector shall be calibrated to trip out when the winding reaches a pre-determined temperature and automatically reset when the temperature returns to a safe limit.

1.4 EFFICIENCY
A. All motors shall be special high efficiency design. These motors shall be different than manufacturers' standard product, in that losses are reduced by incorporation of design features.
including the use of low loss lamination steel, increase in stator/rotor length, increase in copper windings, utilization of high efficiency ventilating fan, computer optimized slot configuration and air gap.

B. All motors shall be all copper wound, high power factor, high efficiency motors. Motor efficiency shall be as determined by IEEE Standard 112A, test method B. Test results shall be submitted to the Engineer.

C. Manufacturer to furnish % efficiency, % PF, amps at Full Load, 3/4 Load, and 1/2 Load with quotation and be prepared to furnish actual test results on individual ratings if required.

PART 2 - PRODUCTS

2.1 GENERAL

A. Motors shall be 60 Hertz voltage as indicated on drawings, Squirrel Cage induction type suitable for across-the-line starting and continuous duty.

B. Motors shall have copper windings.

C. All motors shall be suitable for application without exceeding Class B rise in ambient temperatures up to and including 65 degree C at 1.15 Service Factor. Motor nameplates shall state suitability for 65 degree C ambient application.

D. All motors shall be suitable for application without exceeding Class B temperature rise at altitudes up to and including 9900 feet at a 1.00 Service Factor.

E. Motors shall operate successfully under running conditions at rated load with +10% of rated voltage or +5% of rated frequency or a combined variation in voltage and frequency of +10% (sum of absolute values).

F. Motors will have at least a nominal 85% power factor rating at full load and rated voltage. Exclusion from this requirement are motors which draw less than 1,000 watts at full load and motors with synchronous speeds less than 1800 RPM. Test verification shall be available upon request.

2.2 INSULATION

A. Motors shall have non-hygroscopic Class B or Class F insulation system as required, however, temperature rise shall not exceed Class B rise at rated load per NEMA Standards.

B. The insulation system shall be provided with sufficient treatment so that the completed insulation system will have a minimum resistance of 1.5 megohms after 168 hours of testing to a humidity chamber maintained at 100% relative humidity and 40 degree C ambient.

2.3 TESTS

A. Each motor shall be given a routine factory test per NEMA and ASA Standards to insure compliance with this specification.

2.4 BEARINGS

A. Bearings shall be shielded, regreasable, vacuum degassed steel ball bearings, specially selected for electric motor service and long life expectancy (B-10 MINIMUM).

B. Bearings shall be lubricated with a premium moisture resistant grease formulated to operate over a temperature range of -20 degree F to +300 degree F.
C. Bearing identification by AFBMA number shall be shown on motor nameplate.

2.5 ENCLOSURES

A. Construction shall be of rugged corrosion resistant metal including a one-piece frame, brackets, conduit box and fan shroud.

B. Fans shall be bi-directional and constructed of low inertia inert material.

2.6 CONDUIT BOXES

A. Conduit boxes are to be diagonally split, rotatable in 90 degree turns, gasketed cast iron construction with threaded conduit holes.

B. Ground lug suitable for grounding motor frame shall be furnished inside of conduit box.

C. A neoprene lead seal separator gasket shall be mounted between motor frame and conduit box to prevent entry of moisture and dust into the motor.

D. Conduit box size must meet or exceed minimum as shown in NEC Standards based on motor full load current.

2.7 HARDWARE

A. Corrosion-resistant cadmium plated grease plugs shall be provided for relubrication of bearings.

B. An external shaft flinger shall be provided on the shaft to prevent entrance of moisture or dust into the bearings.

C. All motors Frame 182T and larger shall have lifting eyebolts for lifting the entire motor.

D. An easy-to-read nameplate shall be provided on each motor and shall include at least the following information:

1. Horsepower
2. RPM
3. NEMA Design
4. Phase
5. Hertz
6. Service Factor
7. Ambient Temperature
8. Frame Size
9. Duty
10. Class of Insulation
11. Locked KVA Code
12. Full Load Amps
13. Model or Catalog Number
14. Bearing Identification
15. Guaranteed Minimum Efficiency
16. Nominal Efficiency
17. Voltage

2.8 MOTOR CONSTRUCTION
A. Motors shall be dynamically balanced to limits as indicated below:

<table>
<thead>
<tr>
<th>Speed</th>
<th>Maximum Amplitude (Peak-to-Peak)</th>
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</thead>
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<tr>
<td>3500 &amp; Above</td>
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<tr>
<td>1700 to 3499</td>
<td>.0015</td>
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<tr>
<td>Less than 1700</td>
<td>.0020</td>
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</table>

2.9 FINISH
A. All external surfaces shall be prime painted with red oxide zinc chromate primer to prevent corrosion.
B. The finish coat of paint shall be a full-gloss epoxy enamel paint. External finish shall protect against moisture and have superior heat resistance to withstand the effects of sunlight and outdoor weathering without chipping or cracking.

2.10 EFFICIENCY
A. Motors furnished shall meet or exceed the efficiency listed on the following Table.
## HIGH EFFICIENCY MOTORS

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<tr>
<th>HP</th>
<th>3600 RPM EFFICIENCY</th>
<th>1800 RPM EFFICIENCY</th>
<th>1200 RPM EFFICIENCY</th>
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END OF SECTION 220513
SECTION 220523 - VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
   A. All valves except lubricated plug valves and butterfly valves shall be manufactured by Nibco, Hammond, Lunkenheimer, Kennedy, Stockham, Walworth, Powell or Milwaukee.
   B. Lubricated plug valves shall be as manufactured by Rockwell, Milwaukee or Walworth.
   C. Butterfly valves shall be as manufactured by W.C. Norris, Centerline, Nibco, Demco, Grinell, Milwaukee or Keystone.

1.3 RELATED WORK IN OTHER SECTIONS
   220000 - PLUMBING INDEX
   220500 - GENERAL PLUMBING REQUIREMENTS
   220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
   220700 - PIPING INSULATION
   221113 - DOMESTIC WATER SYSTEMS
   221123 - NATURAL GAS PIPING SYSTEMS
   221313 - SOIL AND WASTE PIPING SYSTEMS
   230519 - PIPING SPECIALTIES

1.4 IDENTIFICATION OF VALVES
   A. Each valve shall be provided with a stamped metal tag secured to the valve with metal chain. Tag shall indicate both the service and function of each valve. The Contractor shall furnish two prints of drawings showing floor plan for each floor with all valves accurately located and labeled. These drawings shall be neat and easily read.

PART 2 - PRODUCTS

2.1 VALVES
   A. Domestic water:
      1. Gate Valves 2” and Under: Nibco No. T134, rising stem, ductile iron hand wheel, union bonnet, solid wedge disc, bronze body, Class 150 psi working pressure.
      2. Gate Valves 2-1/2” and Larger: Nibco No. F617-0, bronze trimmed, solid wedge disc, iron body, O.S. & Y., 125 psi working pressure.
4. Swing Check, 2-1/2" and Larger: Nibco No. F938-31, iron body, bolted bonnet, Class 150, bronze trimmed, check valves installed at discharge of pumps shall be non-slam type.
5. Globe Valves 2" and under: Nibco No. T235, union bonnet, integral seat, Class 150 bronze body with renewable disc.
7. Gate Valves 3” and Under for Copper Pipe: Nibco No. S134, union bonnet, Class 150 bronze rising stem wedge disc.
9. Angle Valves 2” and Under Copper Pipe: Nibco T335, Class 150, Union Bonnet, integral seat, renewable seat & disc.
10. Angle Valves 2 1/2” and Larger: Nibco F8180-B, Class 125, bolted bonnet cast iron, renewable seat & disc., bronze trim.
11. Check Valve for 3” and under for Copper Pipe: Nibco S-433, Y-pattern, swing type, all bronze, renewable seat & disc.
12. Ball Valves:
   a) 1/2” to 2”: Nibco No. T-585-70, two-piece body, bronze, screwed ends, Teflon seats, straight through flow design.
13. Lubricated Plug Valves: Rockwell Mfg. Co. “Permaturn” lubricated plug valves Fig. No. 143. Provide valve handle for each valve. Valves shall have tapered plugs with thermally bonded lubricated film.
14. Water Pressure Relief Valves for makeup to heating and cooling systems, and relief for heating and cooling system, Bell & Gossett No. 1170 unless otherwise noted.
15. Drain Valves: Nibco No. T134, 3” and smaller.

PART 3 - EXECUTION
3.1 INSTALLATION
   A. All valves shall be installed in locations which will allow easy operation and facilitate maintenance.
   B. Gate and globe valves shall be installed with stems up.

END OF SECTION 220523
SECTION 220700 - PIPING INSULATION

PART 1- GENERAL
1.1 SUMMARY
   A. Furnish and Install:
      1. Piping insulation
      2. Jackets and accessories

1.2 RELATED DOCUMENTS:
   A. The General Provisions of the Contract, including General and Special Conditions and the General Requirements apply to the work specified in this section.

   B. Insulation furnished under this specification shall comply with all requirements of the State Energy Code and the recommendations of the latest edition of ASHRAE 90.1 and these specifications. The more stringent of these shall be the standard for the work provided under these specifications.

   C. The work included under this specification consists of furnishing all labor, accessories, equipment and materials necessary for installation of all piping, and mechanical equipment insulation systems. This includes but is not limited to:
      1. Thermal Insulation
         a) Domestic hot water piping
      2. Condensation Prevention Insulation
         a) Domestic cold water piping

1.3 RELATED WORK IN OTHER SECTIONS
220000 – PLUMBING INDEX
220500 – GENERAL PLUMBING REQUIREMENTS
220513 – COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
230500 – GENERAL HEATING, VENTILATING AND AIR CONDITIONING REQUIREMENTS

1.4 REFERENCES
   A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
   F. ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
G. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

H. All preformed Fiberglass pipe insulation with factory applied jackets shall meet the following standards:
   - ASTM E84 - Surface Burning Characteristics of Building Materials
   - ASTM E96 – Jacket Permeance
   - ASTM C335-Steady-State Heat Transfer Properties of Horizontal Pipe Insulation
   - ASTM C547 - Mineral Fiber Preformed Pipe Insulation
   - ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
   - ASTM C795 – Thermal Insulation for use in Contact with Austenitic Stainless Steel
   - ASTM C1136 – Flexible Low Permeance Vapor Retarders for Thermal Insulation: Types I-IV.
   - NRC 1.36 – Nuclear Regulatory Commission Guide 1.36 Non Metallic Thermal Insulation
   - NFPA 90A
   - NFPA 255
   - UL 723 – Composite Surface Burning Characteristic
   - CAN ULC S102-M
   - MIL – I – 22344D – Insulation, Pipe, Thermal, Fibrous Glass
   - MIL – I – 24244C (Ships)
   - USCG 164.109 – Non Combustible Materials
   - New York City MEA
   - GreenGuard Certified for Indoor Air Quality
   - GreenGuard Certified for Children and Schools

1.5 DEFINITIONS

A. Exposed Location: Exposed in mechanical rooms, rooms with finished walls or ceilings, and pipe chase between toilet rooms and equipment rooms.

B. Concealed Location: Located in furred spaces, attics, crawl spaces, above suspended ceilings in finished or unfinished rooms, or all other locations not exposed to view.

C. Cold Piping: Shall include domestic water and other piping with surface temperatures less than 70°F.

D. Hot Piping: Domestic hot water, supply and return and other piping with surface temperatures greater than 105°F.
E. Exterior Locations: All locations exposed, unexposed above grade or below grade beyond the building floor, wall or roof line of the structure or building

F. Location and Insulation Requirements:
   1. Cold Water, including Non-potable Water (NPW): Insulate as follows:
      a) All piping above ceilings and in walls.
      b) Entire system except for stubouts to fixtures.
   2. Domestic Hot: Insulate as follows:
      a) Entire system except for stubouts to fixtures.
   3. K Factors: All K Factors shown in this Specification are expressed in BTU-in/hr.-ft²-F.

1.6 SUBMITTALS
   A. Comply with Section 220500.
   B. Product Data: Provide product description, list of materials and thickness for each service and location.
   C. Manufacturer's Installation Instructions: Indicate procedures, which ensures acceptable workmanship and installation standards will be achieved.

1.7 QUALITY ASSURANCE
   A. Qualifications of Applicator: Company specializing in piping insulation application with five (5) years minimum experience.
   B. Regulatory Requirements Fire Hazard Classification: Insulation shall have a composite (insulation, jacket or facing, and adhesive to secure jacket or facing) fire hazard rating as tested by ASTM E-84, NFPA 255, and UL 723 not to exceed 25 flame spread, 50 fuel contribution, and 50 smoke developed. Materials shall be labeled accordingly.

1.8 DELIVERY, STORAGE AND HANDLING
   A. Compliance: Comply with Section 230500. Deliver materials to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness and store in a warm, dry location.

1.9 PROJECT/SITE CONDITIONS
   A. Storage Environment: Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation while in storage.
   B. Environmental Requirements: Perform work at ambient and equipment temperatures as recommended by the insulation manufacturer.
   C. Protection: Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Repair or replace any such insulation or covering damaged prior to final acceptance of work.
   D. Application Surfaces: Surface shall be dry, free of dust, oil, construction residues or other foreign materials before insulation is applied. Piping joints shall be dry, leak free and tested before application of insulation occurs.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Owens-Corning
   2. Knauf
   3. Johns Manville
   4. Industrial Insulation Group

2.2 MATERIALS

A. Glass Fiber:
   1. Insulation: ASTM C547; rigid molded, noncombustible.
      a) 'K' value: ASTM C335, 0.24 at 75 °F
         1) K values shall conform to the following at 75°F
            (a) Heating water to 250°F: .28
            (b) Heater water and Steam to 350°F or above: .32
            (c) Chilled water 40°F to 55°F: .24
            (d) Domestic water 105°F or greater: .24
         b) Minimum Service Temperature: -20°F
         c) Maximum Service Temperature: +450°F
         d) Maximum Moisture Absorption: 0.2 percent by volume
   2. Vapor Barrier Jacket:
      a) All Service Vapor Retarder Jacket
      b) Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
      c) Secure with self-sealing longitudinal laps and butt strips.
      d) Alternate: Paper Free All Service Vapor Retarder Jacket

2.3 JACKETS

A. PVC Plastic
   1. Jacket: ASTM C921, one piece molded type fitting covers and sheet material, off white color.
      a) Minimum Service Temperature: -40°F
      b) Maximum Service Temperature: +150°F
      c) Moisture Vapor Transmission: ASTM E96; 0.002 percent by volume
      d) Maximum Flame Spread: ASTM E84; 25.
      e) Maximum Smoke Developed: ASTM E84; 50
f) Thickness: 20 mil.
g) Connections: Brush on welding adhesive

2. Covering Adhesive Mastic: Compatible with insulation

3. Acceptable Manufacturers
   a) Proto
   b) Zeston
   c) Speedline

B. Canvas Jacket; UL listed.
   1. Fabric: ASTM C921, 6 oz/sq yd, plain weave cotton treated with dilute fire retardant lagging adhesive.
   2. Lagging Adhesive: Compatible with insulation.
      a) Thickness: 20 mil inch sheet.
      b) Finish: Smooth.
      c) Joining: Longitudinal slip joints with 2 inch laps.
      d) Fittings: 0.016 inch thick die shaped covers with factory attached protective liners.
      e) Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

C. Aluminum Jacket: ASTM B209
   1. Thickness: 0.016 inch sheet.
   2. Finish: Smooth
   4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
   5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

D. Stainless Steel Jacket: Type 304 stainless steel.
   1. Thickness: 0.016 inch
   2. Finish: Smooth
   3. Metal Jacket Bands: 3/8 inch wide; 0.016 inch thick stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect work in conformance with Section 220500.
3.2 PREPARATION

A. Pipe Testing: Testing of piping shall be completed and leaks repaired prior to application of insulation. Surfaces shall be clean and dry before proceeding.

B. Installation: Install materials after piping has been tested and approved. See Section 220500.

C. Surface Cleaning: Clean surfaces for adhesives.

3.3 INSTALLATION

A. Pipe Insulation:

1. Manufacturer's Instructions: Install materials according to manufacturer's instructions.

2. Finished Surface Temperature: Insulation thickness shall conform to those recommended ASHRAE 90.1, latest edition, unless otherwise specified. Thickness of insulation shall be sufficient to keep surface temperatures below 115°F.

3. Continuity: Apply insulation tightly over clean, dry surfaces with sections or edges firmly butted together. Make insulation continuous through sleeves or openings in walls and floors.

4. Make insulation continuous at pipe hangers, trapezes, and other types of supports. Do not notch insulation to fit over hangers, trapezes, and other supports. Install shields at all supports.

5. Name Plates: Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.

6. Supports: Finish insulation neatly at hangers, supports and other protrusions. Locate insulation or cover seams in least visible locations.

7. Inserts: Provide an insert, not less than 6-inches long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 2-inches diameter or larger, to prevent insulation from compressing at support points. Inserts shall be cork, hardwood or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used with field fabricated insulation value equal to insulation approved by the Project Engineer. Do not use calcium silicate inserts or other material that can absorb moisture on any below ambient piping system.

8. Enclosures: Do not insulate hot water heating pipe within radiation enclosures.

9. Flanges: On insulated piping without vapor barrier and piping conveying fluids 140°F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations.

10. Equipment Fittings and Valve Coverings: Insulate all equipment, fittings and valves. Terminate insulation neatly with insulating and finishing cement troweled on bevel.

11. Preformed Fittings Locations: All fittings and valves shall be insulated with preformed fiberglass for fittings, mitered sections of pipe insulation or fiberglass blanket insulation of equal thickness to the adjacent pipe insulation. Cover the fittings, valves and insulation with preformed PVC jacket. Close jacket with stainless steel tacks and compatible adhesive.
12. Radiation Barrier: When insulating hot pipe fittings, a layer of kitchen-type aluminum foil shall be applied over the first fiber glass insert applied, making sure the aluminum foil is extended over the adjacent pipe insulation. A second fiber glass insert shall then be applied over the foil with a vapor seal at all the aluminum foil edges. Insulation thickness shall be such that the surface temperature shall not exceed 115°F.

13. Expansion Devices: On insulated piping with vapor barrier; insulate all equipment, fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

14. Fasteners: Avoid the use of staples on vapor barrier jackets. Seal vapor barrier penetrations with white vapor barrier finish and adhesive.

15. Adhesive Limitations: Apply adhesives to not exceed the coverage recommended by the manufacturer.

16. Wall, Floor and Ceiling Penetrations: Continue insulation with vapor barrier through penetrations including walls, floors and ceilings.

17. Enclosure: All insulation ends shall be firmly butted and secured with minimum 3 inch wide butt strips. Exposed end of pipe insulation shall be sealed with vapor barrier mastic.

18. Repairs: Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.

19. Service Access: When equipment with insulation requires periodical opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage.

20. A complete moisture and vapor seal shall be provided on cold surfaces where vapor barrier jackets or coatings are required. Anchors, hangers and other projections shall be insulated and vapor sealed to prevent condensation. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

21. Insulation shall be installed in a workmanlike manner by workmen regularly engaged in this type of work. Insulation shall not be applied until all surfaces are clean and dry and until inspection and release for insulation application.

   a) Do not notch insulation to fit around trapezes or wall-mounts fabricated from slotted metal framing (“unistrut or equal”), angle iron or other materials. Insulation shall be continuous across the support and an insulation shield shall be installed to prevent crushing the insulation. Pipe clamps shall be sized to fit around insulation and shield.

   b) Insulation may be notched or trimmed around riser clamps. Seal exposed insulation.

B. Jackets:

1. Indoor, Concealed Applications: Insulated pipes conveying fluids above ambient temperature shall have standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish fittings, joints, and valves with premolded PVC jackets secured with stainless steel tacks. The precut insulation shall be held in place by copper wire or...
hemp twine, and be removable without damage to the insulation or jacket. Leave surfaces clean and ready for painting.

2. Indoor, Concealed Applications: Insulated dual-temperature pipes or pipes conveying fluids below ambient temperature shall have vapor barrier jackets, factory-applied or field-applied. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe, and finish with premolded PVC jackets.

3. Indoor, Exposed Applications: Mechanical Equipment Rooms, all insulated piping to be finished with aluminum jacket secured with metal jacket bands.

4. Indoor, Exposed Applications: Same as Indoor, Concealed Applications except that in addition the insulation shall be covered with an aluminum jacket secured with metal jacket bands.

5. Exterior Applications: Same as Indoor, Exposed Applications plus connect with a modified S lock equal to Premetco “Loc-Jack” Z-Crimp, Factory or Field installed. All seams shall be sealed with silicone caulking and have seams oriented so that the jacketing will shed water & not tend to trap and enter rain water.

3.4 APPLICATION

A. Fittings and Valves Insulation:

1. Premolded Fittings: All insulated pipe fittings shall be insulated with 20 mil PVC Zeston one piece premolded insulated fittings wherever possible. If Zeston fittings are not available for the use required, comply with the following paragraph #2. Insulate fittings with fiberglass tightly wrapped with copper wire or heavy hemp twine to within 1/4 inch of thickness of adjoining copper wire or insulation, finished with 1/4 inch of insulating cement troweled flush with pipe insulation. A tack coat of mastic vapor barrier Foster 60-25 or 26 to 1/16 inch thickness or equal shall be applied to fittings and valves. Apply 6 oz. fiberglass canvas jacket to build-up (not PVC) fitting band valve insulation. Cement laps thoroughly with Foster 81-42 or 30-36 adhesive.

B. Perm Rating Vapor Barrier Mastic Coatings:

1. Perm rating not more than 0.25 when tested in accordance with ASTM E-96, Procedure A Fire Retardant.

C. Adhesives, Sealers, Facings, and Vapor Barrier Coatings:

1. Compatible with materials to which applied, and shall not corrode, soften, or otherwise attach the pipe or insulation materials in either the wet or dry state. Use only adhesives, sealers, facings, and vapor barrier coatings recommended by the approved manufacturers of insulation materials.

3.5 SCHEDULE

<table>
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<tr>
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<th>Pipe Size</th>
<th>Thickness</th>
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<td>CW, HW, HWC</td>
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<td>1 inch</td>
</tr>
<tr>
<td></td>
<td>2-1/2 inch and Larger HW, HWC</td>
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</tr>
</tbody>
</table>

END OF SECTION 220700
SECTIO N 221000 - PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 SCOPE
   A. This section of the specifications encompasses the basic materials and methods of the various piping systems covered in Division 25.
   B. Standards: The latest edition of each standard referenced shall be used to determine compliance.

1.3 RELATED WORK IN OTHER SECTIONS
220000 - PLUMBING INDEX
220500 - GENERAL PLUMBING REQUIREMENTS
220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
220523 - VALVES
220700 - PIPING INSULATION
221113 - DOMESTIC WATER SYSTEMS
221123 - NATURAL GAS PIPING SYSTEMS
221313 - SOIL AND WASTE PIPING SYSTEMS
230519 - PIPING SPECIALTIES

1.4 IDENTIFICATION OF PIPING
   A. All accessible piping shall be labeled at not more than 10 ft. intervals with labels indicating the service and direction of flow. Pipe labels shall be self-adhesive labels, all-temperature Perma-Code pipe markers No. B-500, manufactured by the W.H. Brady Company. The background color code for all markers shall conform to the American National Standard A13.1 - 1975 "Scheme for the Identification of Piping Systems."
   B. The color red shall be for the exclusive use on fire protection service piping and sprinkler piping per OSHA regulations (CFR 1910.144).

PART 2 - PRODUCTS

2.1 PIPING SYSTEMS
   A. Exterior Water Distribution
      1. Copper: Type K hard, seamless copper tube conforming to ASTM B-88 with silver brazed joint per ASTM B260 Class BAg-1 with wrought copper fittings per ANSI B16-22.
B. Domestic water system

1. Above grade:
   a) Copper: Shall be Type K soft drawn, or Type L hard drawn, seamless copper tubing conforming to ASTM B88, with wrought copper and bronze solder joint pressure fittings conforming to ANSI B16.22.

2. Underground:
   a) Copper: Type K hard, seamless copper tubing conforming to ASTM B-88 with silver brazed joints (ASTM B-260 Class BAg-1) with wrought copper fittings per ANSI B16.22.

C. Soil and waste system

1. Above ground:
   a) Cast Iron: Shall be cast iron hub and spigot soil pipe or hubless cast iron pipe and fittings, (No-Hub Couplings shall conform to CISPI Standard 310 & ASTM A-1277 or latest edition) conforming to ASTM A74 (latest edition) and/or Cast Iron Soil Pipe Institute (CISPI) CS-888 and shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute. The hub and spigot pipe shall use compression gasket joints per ASTM C-564 & ASTM 1563.

2. Underground inside building:
   a) Cast Iron: Shall be cast iron hub and spigot soil pipe conforming to ASTM A74 (latest edition) and/or Cast Iron Soil Pipe Institute (CISPI) CS-888 and shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute. The hub and spigot pipe shall use compression gasket joints per ASTM C-564 & ASTM 1563.

3. Underground outside buildings:
   a) Under traffic areas and parking lots: Shall be cast iron hub and spigot soil pipe conforming to ASTM A74 and Cast Iron Institute CISPI 301.
   b) Risers and base fittings for grade cleanouts shall be extra heavy cast iron pipe and fittings with compression joints per ASTM C-564 & ASTM-1563.

4. Manholes:
   a) Manholes shall be of either precast or brick construction. Precast shall be 48" diameter, Class II, Type V reinforced concrete per ASTM C-478. Top section shall be built to grade with brick or concrete grade rings. Brick manholes shall be constructed to the standard and with approval of local jurisdiction authorities.

   b) Frame and covers shall consist of grey iron, ASTM Class 45 with lid indexed "Sanitary Sewer" or "Storm Sewer" as applicable. Frame and cover shall be Neenah Foundry Company model R-1370 with Type C lid or equal.

D. Sanitary vent system

1. Vent piping 2" and smaller in diameter may be schedule 40 galvanized steel pipe conforming to ASTM A-53 with 150 pound galvanized malleable iron screwed fittings
conforming with ANSI B16.3. Vent piping larger than 2” shall be cast iron as specified for interior soil and waste.

E. Natural gas piping system

1. Black steel: Above grade piping shall be Schedule 40, black steel pipe conforming to ASTM A-53, with 150 pound malleable iron screwed fittings conforming with ANSI B16.3. or seamless carbon steel weld fittings conform to ASTM A-234.

2. Underground piping shall be schedule 40 black steel pipe conforming to ASTM A-53 machine wrapped with Scotchwrap PVC tape using 50% overlap. Fittings and joints shall be double wrapped to a minimum 6 inches beyond the fitting. Pipe shall be primed prior to wrapping per manufacturer's recommendations.

2.2 JOINTS

A. Copper:

1. Silver brazed joints shall use brazing material containing approximately 45% silver, 15% zinc, 25% cadmium and 15% copper. Joints shall conform to ASTM B-260 Class BAg-1. Approved materials include Mueller #122, Handy and Harmon "Easy Flo45" and United Wire and Supply "Sil-Bond 45".

B. Cast Iron:

1. Neoprene Rubber gaskets for hub and spigot piping per ASTM C564.

2. No hub joints shall consist of couplings that conform to CISPI 301.

C. Black Steel:

1. Screwed joints shall be made with no more than three threads showing using teflon tape or teflon joint sealing compound.

2. Welded joints shall be fusion welded to full metal depth with width at least 2 1/2 times the depth of the metal being joined.

D. Insulating joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe. Insulating joints shall consist of a sandwich type flange insulating gasket of the dielectric type, insulating washers and insulating sleeves for flange bolts. Gaskets shall be full faced. Bolt insulating sleeves shall be full length. Units shall be of a construction to prevent metal to metal contact of dissimilar piping materials.

2.3 FLOOR, WALL AND CEILING PLATES

A. Where exposed pipes pass through finished floors, finished walls or finished ceilings, they shall be fitted with chromium plated spun brass flanges or flanges to match the type of pipe or pipe finish used. Plates shall be large enough to completely close the hole around the pipe and shall be not less than 1-1/2" or more than 2-1/2" larger than the diameter of the pipes. All plates shall be securely held in place.

2.4 UNIONS

A. Piping 2-1/2” and larger to have bolted flange unions with gaskets of material suitable for the specified service. Ground joint unions with brass to iron seats shall be used in piping 2" and smaller. Unions shall be installed at all valves and equipment connections.

B. Insulating Unions: See Specification Section 230519.
2.5 HANGERS AND ANCHORS

A. To prevent galvanic action between copper pipe and a dissimilar metal, copper pipe shall be isolated to prevent the pipe from contacting the dissimilar metal. This may be accomplished by mounting the pipe in an isolation fitting, or by wrapping the pipe with a 20-mil thickness of UPC-rated isolation tape. The 20-mil thickness can be accomplished by using a single wrap of 20-mil tape or by using 10-mil tape with a 50% overlap.

B. Copper pipe does not need to be isolated from copper plated pipe hangers that are suspended from hanger rods.

C. Copper pipe mounted on slotted metal framing (“unistrut or equal”), angle iron, or other dissimilar metal support shall be isolated as described above, even if pipe clamps used are copper plated. Painted, epoxy or powder-coated finishes on the metal support are not an acceptable means of isolation.

D. All piping shall be rigidly supported from the building structure by means of adjustable ring type hangers. Where pipes run side by side, support on rod and angle trapeze hangers. Hangers shall be spaced not greater than 5 feet on centers for cast iron piping, 6 feet on centers for copper piping and 10 feet on centers for steel piping. Plastic pipe shall be supported on not more than 3 feet centers. Round rods supporting the pipe hangers shall be of the following dimensions:

1. 1/2 inch to 2 inch pipe 3/8 inch rod
2. 2-1/2" inch to 3 inch pipe 1/2 inch rod
3. 4 inch to 5 inch pipe 5/8 inch rod

E. Rods for trapeze hangers shall be a minimum of 3/4 inch and shall have the equivalent cross section listed above per pipe supported. The use of pipe hoods, chains, or perforated iron for pipe supports will not be permitted. Insulated piping shall have hangers outside of insulation with 18 ga. protection sleeves 12" long. Anchors and guides shall be as detailed on the drawings. The Contractor shall provide inserts in the building construction at the time the concrete is poured, and the hangers shall be attached to these inserts. Where inserts cannot be used expansion shields may be used provided the hanger is not attached rigidly to the bolt but is supported from an angle held in place by the expansion bolt. The use of expansion shields must be approved by the Architect/Engineer. See drawings and details for support of tunnel piping.

F. Hanger rods for all equipment, pipes, ducts, trapezes, vibration isolators, etc., shall be installed straight, true and plumb. Do not bend or flex hanger rods to accommodate sloping structures, avoid obstacles, or for any other purpose. Where necessary, utilize swivel beam clamps, beveled or swivel hardware, angled, swivel or hinged brackets spanning members or other appropriate means of connection.

2.6 THRUST BLOCKS

A. All underground water line tees, crosses, bends and valves shall be provided with concrete blocking. Concrete blocking shall be used for cast-iron or vitrified clay tile fittings where a change of flow direction occurs. All fittings at bends in the pipe line shall be firmly wedged against the vertical face of the trench by means of concrete thrust blocks bearing on undisturbed earth, to prevent the fittings from being blown off the line when under pressure. Fittings at vertical bends downward shall be anchored with concrete anchors as required. Thrusts blocks shall be determined using an allowable soil bearing pressure of 1,500 PSF at
200 psi test pressure in water line. No blocking will be covered or backfilled until inspected and approved by the Architect/Engineer.

2.7 VALVE BOXES

A. Valve boxes shall be of cast iron extension type with flared base and shall be M & H Valve and Fittings Company, two-piece, 5 1/4" shaft, screw type to fit depth of bury. The minimum thickness of metal shall 3/16" and the nominal diameter of the box shall be at least four inches. The cover shall have the name of the utility service cast in the metal. Boxes shall be installed over each outside gate valve unless otherwise shown on the drawings. The boxes shall be of such length as will provide without extension a cover of not less than three feet over all water pipes. Valve boxes shall have concrete collars.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide and erect in a workmanlike manner according to the best practices of the trade all piping shown on drawings and required for the complete installation of the systems. The piping shown on the drawings shall be considered as diagrammatic for clarity in indicating the general run and connections, and may or may not in all parts be shown in its true position. The piping may have to be offset, lowered or raised as required or as directed at the site. This does not relieve the Contractor from responsibility for the proper erection of systems or piping in every respect suitable for the work intended as described in the specifications and approved by the Architect/Engineer.

B. In the erection of all piping, it shall be properly supported and proper provisions shall be made for expansion, contraction and anchoring of piping. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing or forcing, properly clearing equipment and all windows, door, and other openings. Cutting or other weakening of the building structure to facilitate installation will not be permitted. All pipes shall have burrs and/or cutting slag removed by reaming or other cleaning methods. All changes in direction shall be made with fittings.

C. All open ends of pipes and equipment shall be properly capped or plugged with plugs manufactured for this purpose to keep dirt and other foreign materials out of the system. Plugs of rags, wool, cotton waste or similar materials may not be used in plugging.

D. All piping shall be arranged avoiding interference with removal and maintenance of equipment, filters or devices; and not blocking access to manholes, access openings, etc. Flanges or unions as applicable for the type of piping specified shall be provided at the piping connections to all items of equipment.

E. Valves and specialties shall be placed to permit easy operation and access, and valves shall be regulated, packed and adjusted at the completion of the work before final acceptance.

F. All piping shall be erected to insure proper draining. Domestic water piping may be run level but shall be free from traps.

G. Soil and waste piping and other gravity drains shall be sloped down in direction of flow minimum one inch in 20 feet.
3.2 ACCESS DOORS

A. Furnish all access doors required for access to valves, controls, or other items for which access is required for either operation or servicing. All costs incurred through failure to perform this function as the proper sequence of the work dictates shall be borne by this Mechanical Contractor.

B. The type of access door shall be as required by the room finish schedule. Acoustical tile access doors shall be equal to Krueger Style B, Style A for acoustical plaster, or Style C-CF for sidewall drywall or plaster construction.

3.3 JOINTS

A. Resilient molded gaskets shall be used on hub and spigot piping. For cast iron soil pipe not located under buildings, the Contractor may also use the No-hub sanitary system for pipe 6" and below with neoprene sealing gaskets, stainless steel retaining sleeves and two draw bands. An adequate torque wrench shall be used for system installation in accordance with manufacturer's recommendations.

B. Screwed Joints: Screwed joints shall be American Standard taper pipe threads. Ream pipe ends and remove burrs after threading. Make up joints using an approved compound or teflon tape, applied to the male threads only.

C. Brazed and Soldered Joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool before sweating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections.

D. Welded Joints: On black steel piping 2 inches and above in size, the joints shall be welded. Welding shall be done using either gas or electric welding equipment. Certified welders shall be used. All pipe surfaces shall be thoroughly cleaned before welding. Each joint shall be beveled before being welded. Piping shall be securely aligned and spaced and the width of circumferential welds shall form a gradual increase in thickness from the outside surface to the center of the weld. The Contractor shall use appropriate materials to protect the structure and provide adequate fire protection at all locations where welding is done. All elbows shall be long radius unless otherwise specified. Wherever tee connections are made to piping systems on the main run, welding sockets may be installed for the branch connections up to one half the size of the main run. On connections larger than one half the size of the main run, welding tees shall be used. The use of fittings formed from welded pipe sections will not be permitted.

3.4 PUMP AND EQUIPMENT CONNECTIONS

A. All piping connecting to pumps or other equipment shall be installed with isolation valves and flexible connections to prevent strain at the connection to equipment. The Contractor shall be required as directed to disconnect piping to demonstrate that piping has been so connected. Provide a suction diffuser at each end suction pump where the inlet piping has a straight run of less than 15 pipe diameters in length. Suction diffusers shall consist of angle type body with inlet vanes and combination diffuser-strainer-orifice cylinder with 3/16 inch diameter openings for pump protection. Strainer free area shall be five times the section area of the pump connection. Provide an adjustable support foot for diffusers installed on end suction pumps.

3.5 PIPE SLEEVES

A. Pipe sleeves shall be furnished and set by the Contractor, and the Contractor shall be responsible for their proper and permanent location. Piping will not be permitted to pass through footings, beams or ribs unless so noted on the drawings or with the consent of the
Pipe sleeves shall be installed and properly secured in place at all points where pipes pass through concrete or masonry construction and through all exterior walls, regardless of construction. Pipe sleeves, except sleeves in footings and beams shall be of sufficient diameter to provide approximately 1/4-inch clearance around the pipe, and in cases of insulated pipes, approximately 1/4-inch around the insulation. Pipe sleeves in footings and beams and exterior walls shall be of steel pipe. Sleeves in footings shall be not less than one inch or more than two inches larger in diameter than the pipe to be installed. Pipe sleeves in floors shall be cut flush with finished floor. Openings between piping and sleeves shall be made watertight with plastic cement to a minimum depth of two inches. Openings between piping and sleeves in all masonry or concrete interior walls and partitions shall be similarly caulked for acoustical reasons.

3.6 EXPANSION AND CONTRACTION
   A. The Contractor shall make all necessary provisions for expansion and contraction of piping with offsets or loops and anchors to prevent undue strain.

3.7 PROTECTIVE COATINGS
   A. All underground pipe except exterior cast iron water distribution pipe shall be wrapped with "Scotchwrap" No. 50 tape to give not less than two complete layers on the entire underground piping system, or piping shall have X-TRU Coat factory applied plastic protective covering.
   B. All buried exterior cast iron water distribution piping shall be tar coated.

3.8 TESTING
   A. Before any insulation is installed or before piping is covered or enclosed all piping systems shall be tested and proved tight at not less than 1 1/2 times the maximum service pressure which the piping systems will be required to handle, unless otherwise specified.
   B. All tests shall be conducted in the presence of the Architect/Engineer and the building Owner or his representative. Any systems failing to meet the specified test requirements shall be corrected and retested until the test requirements are met.

3.9 FLUSHING, DRAINING AND CLEANING PIPE SYSTEMS
   A. The Contractor shall flush water piping systems with water before placing them in operation. After systems are in operation and during the test period all strainer screens shall be removed and thoroughly cleaned. The Contractor shall notify the Architect/Engineer in writing when this requirement is to be accomplished.
   B. All domestic water lines shall be sterilized as described in Section 221113 - DOMESTIC WATER SYSTEM of these specifications.

END OF SECTION 221000
SECTION 22 113 - DOMESTIC WATER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
A. The Contractor shall furnish and install the Domestic Water System as shown on the drawings including specialties shown or called out in the fixture and/or equipment list and as necessary for satisfactory operation of the system.

1.3 RELATED WORK IN OTHER SECTIONS
220000 - PLUMBING INDEX
220500 - GENERAL PLUMBING REQUIREMENTS
220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
221000 - PIPE AND PIPE FITTINGS
220523 - VALVES
220700 - PIPING INSULATION
230519 - PIPING SPECIALTIES

1.4 STERILIZATION
A. All domestic water piping shall be sterilized as described in Part 3 of this section.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS
A. Pipe and pipefittings shall be as described in Section 221000 - PIPE AND PIPE FITTINGS.

2.2 SHOCK ABSORBERS
A. Shock absorbers and/or air cushions shall be installed where shown on the drawings. Shock absorbers shall be equal to Zurn Z-1700, Diatrol Series 500 or approved equal sized for the system being protected.

PART 3 - EXECUTION

3.1 INSTALLATION
A. The installation shall conform to the requirements of Section 220500 - GENERAL PLUMBING REQUIREMENTS, and Section 221000 - PIPE AND PIPE FITTINGS.
B. Insulating couplings shall be furnished and installed at all connections between copper and steel pipe to prevent electrolysis.
C. Each water service main, branch main, riser and branch to a group of fixtures shall be valved. Stop valves shall be provided at each fixture.

3.2 STERILIZATION

A. Domestic Water lines shall be sterilized as follows: Chlorine shall be applied to provide a solution of not less than 250 PPM. The chlorinating material shall be introduced into the waterline in a manner approved by the Architect/Engineer. The solution shall be circulated if provided with pumps and all valves in the line shall be operated several times during the contact period. After a contact period of no less than eight (8) hours the system shall be flushed with clean water until the residual chlorine content is not greater than 0.2 PPM.

B. The sterilization procedure shall be witnessed by the Architect/Engineer and Owner.

3.3 TESTS

A. General: All tests shall be conducted in the presence of the Architect/Engineer or his representative. Any systems failing to meet the specified test requirements shall be corrected and retested until the test requirements are met.

B. Water Systems: The complete water systems shall be hydrostatically tested at a pressure of 150 psi and shall show no loss in pressure for a period of one hour.

END OF SECTION 221113
SECTION 221123 - NATURAL GAS PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. The Contractor shall furnish and install the Natural Gas System as shown on the drawings including specialties necessary for satisfactory operation of the system.

1.3 RELATED WORK IN OTHER SECTIONS

220000 - PLUMBING INDEX
230500 - GENERAL PLUMBING REQUIREMENTS
220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
220523 - VALVES
221000 - PIPE AND PIPE FITTINGS

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Pipe and pipe fittings shall be as described in Section 221000 - PIPE AND PIPE FITTINGS.
B. All underground gas piping shall be welded.
C. Any underground gas piping shall have a protective coating as specified in Section 221000 - PIPE AND PIPE FITTINGS.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish and install all piping as indicated on the drawings, and all accessories in strict accordance with the applicable gas code.
B. All gas piping in any utilities tunnel shall be isolated from any metal to metal contact with hangers, supports, rails, etc.
C. Ventilated conduit shall be used to carry natural gas piping whenever such piping is run under any building, building sidewalk, structure, or through or within a concealed return air space. Ventilated conduit construction shall conform to the details shown on the drawings.
D. Gas trains connecting gas fired equipment shall conform to UL requirements.
E. All equipment (AHU, AC, Water Heaters, etc.) connected to the gas system shall be connected with gas valve, union, dirt leg with removable cap (up 4” above any surface) and flexible connection.
F. All piping and accessories shall be supported by unistrut brackets and gasketed pipe clamps, inside of the building.

3.2 TESTS

A. All gas piping shall be tested with air pressure of 60 psi and shall show no loss in pressure for a period of 24 hours on a gauge for recording pressure.

END OF SECTION 221123
SECTION 221313 - SOIL AND WASTE PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
A. The Contractor shall furnish and install the soil and waste piping system as shown on the drawings including specialties shown or called out in the equipment list and as necessary for satisfactory operation of the system.

1.3 RELATED WORK IN OTHER SECTIONS
220000 - PLUMBING INDEX
220500 - GENERAL PLUMBING REQUIREMENTS
220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
221000 - PIPE AND PIPE FITTINGS

1.4 REQUIREMENTS
A. See Sections 220500 - GENERAL PLUMBING REQUIREMENTS and 221000 - PIPE AND PIPE FITTINGS for general requirements.
B. Furnish and install all concrete, grout and other required materials to fill all block outs and/or sleeves left open for this Subcontractor's convenience or for the installation of this work.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS
A. The pipe and pipe fittings shall be as described in Section 221000 - PIPE AND PIPE FITTINGS.

2.2 FLOOR DRAINS
A. Drains shall be Zurn, Wade or Smith and shall be equal to those specified on the drawings.

2.3 FLOOR SINKS
A. Drains shall be Zurn, Wade or Smith and shall be equal to those specified on the drawings.

2.4 CLEANOUTS
A. Cleanouts shall be as manufactured by Zurn, Wade or Smith and shall be of the same size as the pipe except that cleanout plugs larger than four inches will not be required. Cleanouts installed in connection with cast iron soil pipe shall consist of a long sweep, quarterbend or one or two eighth bends extended to an easily accessible place, or as indicated on the drawings.
B. Cleanouts in finish floors shall be of the type made to match the floor and/or covering. All exposed metal shall be polished or chrome plated brass.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall conform to Section 220500 - GENERAL PLUMBING REQUIREMENTS, and Section 221000 - PIPE AND PIPE FITTINGS.

B. Flashings: Vent pipes shall be flashed and made watertight at the roof with sheet lead flashing. Flashing shall weigh at least four pounds per square foot, shall be 24 inches square and shall be turned up around the pipe and into the top of the pipe. Vent pipes shall extend at least 12 inches above roof.

C. Traps: Each fixture and piece of equipment connecting to the drainage system shall be equipped with a trap. Each trap shall be placed as near to the fixture as possible and no fixture shall be double trapped.

D. Floor Drains: All floor drains shall be installed with grates square with the building lines.

3.2 TESTS

A. The entire sanitary system shall be tested in accordance with the requirements of the State Plumbing Code, all local codes and ordinances, and the Uniform Plumbing Code.

END OF SECTION 221313
SECTION 224200 - PLUMBING FIXTURES

PART 1 - GENERAL
1.1 SCOPE
   A. Plumbing fixtures shall be supplied, set and connected as shown on plans. Fixtures shall be protected from damage during construction and shall be thoroughly cleaned of all tape, paint and adhesive prior to final acceptance.

PART 2 - PRODUCTS
2.1 PLUMBING FIXTURES
   A. Plumbing fixtures shall be as manufactured by KOHLER, AMERICAN STANDARD or SLOAN and shall be as scheduled on the drawings.
   B. Flush valves shall be as manufactured by Zurn, Delany or Sloan.

2.2 FITTINGS AND PIPES
   A. Fittings and piping shall be brass and whenever exposed, shall be polished chrome-plated. Provide tight fitting wall and/or floor escutcheons of chrome-plated brass whenever pipes pass through floors, wall or ceilings.
   B. All porcelain or vitreous china shall be clean, smooth and bright. All shall be warranted not to craze, discolor or scale.
   C. This contractor shall furnish and install all required water, waste, soil and vent connections to all plumbing fixtures together with all fittings, supports, fastening devices, cocks, valves, traps, etc., leaving all in complete working order.
   D. All automatic or self-closing valves for faucets shall be adjusted in accordance with manufacturer's instructions and supervised as necessary by equipment supplier's representative at the request of the Architect or Engineer.
   E. Owner furnished equipment shall be connected with drains, traps, hot water, cold water and other services required for optimum operation. This contractor shall obtain information from the Owner or his approved representative for services required or field verify specific requirements.

END OF SECTION 224200
SECTION 230000 - HEATING, VENTILATING, AND AIR CONDITIONING INDEX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish all service tools, equipment, etc., which are required for the complete installation of all Heating, Ventilating, And Air Conditioning Work, as indicated on the Drawings and specified herein. Heating, Ventilating, And Air Conditioning work indicated on the Drawings and/or specifications covering other trades shall conform to Division 23 of these Specifications.

B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Heating, Ventilating, And Air Conditioning systems, shall be accomplished without additional cost to the Owner.

C. Furnish all labor and materials required for Heating, Ventilating, and Air Conditioning service connections to all the various items of equipment requiring connection throughout the project shown on the Contract Drawings (even if not shown on Heating, Ventilating, and Air Conditioning Drawings). Coordinate with other trades for the installation of required connections and service.

1.3 HEATING, VENTILATING AND AIR CONDITIONING DIVISION INDEX

230100 DEMONSTRATION AND TRAINING
230500 GENERAL HEATING, VENTILATING, AND AIR CONDITIONING REQUIREMENTS
230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230519 PIPING SPECIALTIES
230593 BALANCING OF MECHANICAL SYSTEMS
230713 DUCT INSULATION
233000 AIR DISTRIBUTION

PART 2 – PRODUCTS

PART 3 - EXECUTION

END OF SECTION 230000
SECTION 230100 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
A. After completion of the installation and upon completion of the Test and Balancing, the Contractor shall schedule the System Demonstration, Operating Test, and Training Session for the Owner.
B. The following individuals, companies or representatives thereof shall be in attendance.
   1. Mechanical Trade
   2. Electrical Trade
   3. Sheet Metal Trade
   4. Controls Trade
   5. Test and Balance Agency

1.3 RELATED WORK IN OTHER SECTIONS
230000 - HEATING, VENTILATING AND AIR CONDITIONING INDEX
230500 - GENERAL HEATING, VENTILATING, AND AIR CONDITIONING REQUIREMENTS
230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

1.4 QUALIFICATIONS
A. The representatives listed in 1.2B above shall be thoroughly familiar with the operation and function of the equipment or systems he represents and be prepared to indoctrinate the Owner or his designated personnel.

PART 2 - PRODUCTS

2.1 SCHEDULE
A. The Contractor shall schedule and coordinate the System Demonstration and Training Session for the Owner over 1 consecutive 8 hour working day.
B. The Owner may, after the training session has started:
   1. Excuse the equipment manufacturer when his indoctrination session is completed.
   2. Conclude the session early if he feels the intent and purpose of the session has been met.

2.2 ADJUSTMENTS
A. The Contractor shall have available, tools, equipment and personnel to readjust or refine the operation of any part of the mechanical system as directed by the Owner or Architect/Engineer.
PART 3 – EXECUTION

3.1 TRAINING

A. The Contractor shall schedule and coordinate the indoctrination of the Owner and his designated personnel during the Operating Test. The proposed time schedule shall be coordinated with the individuals, companies or representatives who will be conducting the indoctrination and training. This proposed time schedule shall be submitted to the Architect/Engineer for approval.

B. Before final inspection, instruct Owner’s designated personnel in operation, adjustment, and maintenance of products, equipment, and system at agreed upon times.

C. For equipment requiring seasonal operation, perform instructions for other seasons within six (6) months.
   1. Contractor shall provide a minimum of eight (8) hours of training for seasonal system operation.
   2. Contractor shall prepare a written report of training and submit to architect upon completion of training.

D. Use operation and maintenance manuals as a basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

E. Prepare and insert additional data in Operation and Maintenance manual when need for such data become apparent during instruction.

3.2 DOCUMENTATION

A. The Contractor shall prepare an indoctrination schedule similar to the following:

<table>
<thead>
<tr>
<th>INDOCTRINATION SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT</td>
</tr>
<tr>
<td>LOCATION</td>
</tr>
<tr>
<td>PERSONNEL</td>
</tr>
<tr>
<td>TIME</td>
</tr>
</tbody>
</table>

B. The Owner shall initial each line to verify attendance.

3.3 OPERATING INSTRUCTIONS

A. The operating instructions specified in Sections 230500 and 253000 of these specifications shall be presented at the start of the Session. These instructions shall include manufacturer's published data having all information that does not apply crossed out.

3.4 OPERATING TEST

A. The Contractor shall conduct an operational test on all equipment installed under this Division of the Specifications. This test shall be continuous for a minimum of three consecutive days within seven days prior to the demonstration and training period with required data available at the demonstration and shall continue during the demonstration period. The test shall verify the operation of the mechanical systems and demonstrate the performance of the total system.

B. The following data shall be recorded hourly during normal building occupancy hours.

DEMONSTRATION AND TRAINING
1. **Outdoor ambient temperatures:**
   a) Measure and record outdoor dry bulb and wet bulb temperature.
   b) Calculate and record relative humidity.

2. **Indoor space temperature:**
   a) Measure dry bulb temperature in several rooms served by each air handling unit including at least one room in each control zone. Note any variation over 2°F from setpoint.
   b) Measure wet bulb temperature in each space having a space humidistat. Calculate space relative humidity and note any variation over 5% from setpoint.

3. **Water Temperatures:**
   a) Entering and leaving each piece of equipment having a water temperature change including:
      1) Air Handling Unit coils

4. **Air Temperatures:**
   a) Entering and leaving each piece of equipment having air temperature change including:
      1) DX refrigeration coils
      2) Air Handling Unit return, OSA and mixed air

5. **Air Pressure:**
   a) Building static pressure relative to ambient (outside)
   b) Supply static pressure at outlet of each air handling unit
   c) Supply static pressure at the end of each duct run
   d) Supply static pressure at the inlet of each variable air volume terminal

6. **Weather Conditions:**
   a) Sun
   b) Wind velocity
   c) Precipitation
   d) Barometric pressure

3.5 **READINGS AND MEASUREMENTS**

A. The Test and Balance Agency shall be available and take any or all readings and measurements required or desired by the Owner or Architect/Engineer during this Demonstration and Training Session.
PART 1- GENERAL

1.1 SUMMARY

A. Section Includes: General Mechanical Requirements specifically applicable to Division 23 sections in addition to Division 1- General Requirements.

B. Scope:
1. The work covered by this division consists of performing all operations in connection with the installation of heating, cooling, ventilating, and plumbing including site utility work as indicated under this section. This entire section applies to all mechanical work and all mechanical sections of these specifications. This Contractor shall read and comply with all sections of these specifications including all General and Special Conditions.

1.2 REFERENCES

A. Standard Requirements:
1. For products or workmanship specified by association, trades, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. All work shall be executed in accordance with the local and state codes, ordinances, and regulations governing the particular class of work involved. This Contractor shall be responsible for the final execution of the work under this heading to suit these requirements. In the event of a conflict between the various codes and standards, the more stringent shall govern. Where these specifications and accompanying drawings conflict with these requirements, the Contractor shall report the matter to the Architect/Engineer. The Architect/Engineer shall prepare any supplementary drawings required, illustrating how the work may be installed so as to comply. On approval of the change by the Architect/Engineer, the Contractor shall install the work in a satisfactory manner without additional cost to the Owner. On completion of the various parts of the work, the installation shall be tested by the constituted authorities and approved, and on completion of the work, this Contractor shall obtain and deliver to the Owner final certificates of acceptance. This Contractor shall furnish copies of each certificate to the Architect/Engineer.

C. The Contractor shall secure all permits and licenses for his work and shall pay all fees in connection with such permits and licenses.

D. The contractor shall hold and save the Owner free and harmless from liability of any nature or kind arising from his failure to comply with codes and ordinances.

E. Any and all meter deposits and all utility extension costs shall be paid by the Contractor whose work is done in connection with the service that the meter is connected to.

F. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

1. AABC Associated Air Balance Council
2. ADC Air Diffusion Council
   435 North Michigan Ave.
   Chicago, IL 60611
3. AGA  American Gas Association
   1515 Wilson Boulevard
   Arlington, VA  22209

4. AMCA  Air Movement and Control Association
   30 West University Drive
   Arlington Heights, IL  60004

5. ANSI  American National Standards Institute
   1430 Broadway
   New York, NY  10018

6. ASHRAE  American Society of Heating Refrigerating and Air Conditioning Engineers
   345 East 47th Street
   New York, NY  10017

7. ASME  American Society of Mechanical Engineers
   345 East 45th Street
   New York, NY  10017

8. ASTM  American Society for Testing and Materials
   1916 Race Street
   Philadelphia, PA  19103

9. AWWA  American Water Works Association
   6666 West Quincy Avenue
   Denver, CO  80235

10. AWS  American Welding Society
    2501 NW 7th Street
    Miami, FL  33125

11. FM  Factory Mutual System
    1151 Boston-Providence Turnpike
    Norwood, MA  02062

12. FS  Federal Specification
    General Services Administration
    Specifications and Consumer Information Distribution
    Section (WFSIS)
    Washington Navy Yard, Building 197
13. NBFU
   National Board of Fire Underwriters
   5530 Wisconsin Avenue, Suite 750
   Chevy Chase, Maryland 20815

14. NEC
   National Electric Code (of NFPA)

15. NEBB
   National Environmental Balancing Bureau
   8224 Old Courthouse Road
   Vienna, VA 22180

16. NEMA
   National Electrical Manufacturer's Association
   2101 L Street, NW
   Washington, DC 20037

17. NFPA
   National Fire Protection Association
   Battery March Park
   Quincy, MA 02269

18. NSF
   National Sanitation Foundation
   Box 1468
   Ann Arbor, MI 48106

19. OSHA
   Occupational Safety and Health Administration
   U.S. Department of Labor

20. SMACNA
    Sheet Metal and Air Conditioning Contractor's
    National Association
    8224 Old Courthouse Road
    Vienna, VA 22180

21. TIMA
    Thermal Insulation Manufacturers Association
    Technical Services
    1420 King Street
    Alexandria, VA 22314

22. UL
    Underwriters Laboratories, Inc.
    333 Pfingston Road
    Northbrook, IL 60062

G. Underwriters Laboratories Inc. (UL): All materials, appliances, equipment, devices or
   appurtenances shall conform to the applicable standards of Underwriters Laboratories Inc.,
   where such standards have been established.
1.3 DRAWINGS

A. Drawings and specifications shall be considered as cooperative, and work or materials called for by one and not mentioned in the other, or vice versa, shall be done and furnished as though treated by both.

B. In the cases of discrepancies in figures, drawings, or specifications, the Architect/Engineer shall be notified immediately and his decision shall determine the necessary adjustment. Without such decision, said discrepancies shall not be adjusted by the Contractor save only at his expense, and, in case of any settlement or any complication arising from such adjustment to the Contractor, he shall bear all extra expense involved.

C. Should it appear that the work intended to be done, or any of the matters relative thereto, are not sufficiently detailed or explained on the drawings or specifications, the Contractor shall apply to the Architect/Engineer for such further drawings or explanations as may be necessary, allowing a reasonable time for the Architect/Engineer to supply same, and the Contractor shall conform to same as part of the Contract.

D. Should any doubt or question arise in respect to the true meaning of the drawings or specifications, reference shall be made to the Architect/Engineer whose decision shall be final and conclusive. No alleged oral admission, condonation, or inadvertent neglect on the part of the Architect/Engineer will be accepted as an excuse for inferior work.

E. The mechanical plans do not give exact details as to elevations of ductwork and piping, exact locations, etc., and do not show all offsets, control lines, pilot lines, and other installation details. The Contractor shall carefully lay out his work at the site to conform to the structural conditions, provide proper grading of lines, to avoid all obstructions, to conform to details of installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated, satisfactory operational installation.

F. Should the particular equipment which any Bidder proposes to install, require other space conditions than those indicated on the drawings, the Bidder shall arrange for such space with the Architect/Engineer before submitting his bid. Should changes become necessary on account of failure to comply with these details, the Contractor shall make such necessary changes at his (the Contractor's own expense).

G. The Contractor shall submit working scale drawings of all his apparatus and equipment which in any way varies from these specifications and plans which shall be checked by the Architect/Engineer and approved before the work is started, Contractor before work proceeds. Interference with structural conditions shall be corrected by the Contractor.

H. All equipment shall be installed in accordance with the manufacturer's recommendations. Provide all accessories and components for optimum operation as recommended by the manufacturer.

I. Site visit: The Contractor shall visit the site prior to bidding and satisfy himself as the conditions under which the mechanical systems are to be installed. No subsequent allowance shall be made in his behalf for failure to make such a visit. Contractor shall examine all work noted under the demolition drawings and all new work and shall satisfy himself as to the extent of work required to be completed.

1.4 SYSTEM DESCRIPTIONS

A. Not Used.
1.5 PRIOR APPROVALS

A. Each equipment item for which the Contractor desires to install equipment other than the specific item identified in the equipment schedule or equivalent equipment by manufacturers specifically named in the schedule, the Contractor shall bear full responsibility to prove to the Engineer that the furnished equipment is equivalent to or better than the specified item. Failure to provide such proof will result in rejection of the shop drawing submittal by the Engineer. Prior written or verbal approval by the Engineer of equipment by other manufacturers will not relieve the Contractor of responsibility to provide equivalence. Prior approval is not required, however, any prior approval given is intended only to provide preliminary agreement that the alternate manufacturer may make equipment that complies with the specification requirements and not that all equipment manufactured by him is acceptable.

1.6 SHOP DRAWINGS

A. Shop drawings or fully descriptive catalog data shall be submitted by the Contractor for all items of material and equipment furnished and installed under this Contract. This shall include piping, ductwork, mechanical equipment, plumbing equipment, control items, etc. The Contractor shall submit to the Architect/Engineer a sufficient number of copies of all such shop drawings or catalog data to provide him with as many review copies as he may need, plus three (3) copies for retention by the Architect/Engineer. No materials or equipment shall be installed until officially approved by the Architect/Engineer.

B. Before submitting Shop Drawings to the Architect/Engineer for review, the Contractor shall examine them and satisfy himself that they are correctly representative of the material or equipment to which they pertain. The Contractor shall so note these Drawings before submitting them. The Contractor's review of Shop Drawings is not intended to take the place in any way of the official review of the Architect/Engineer, and the Shop Drawings which have not been reviewed by the Architect/Engineer shall not be used in fabrication or installing any work.

C. The review of Shop Drawings or catalog data by the Architect/Engineer shall not relieve the Contractor from responsibility for deviations from the plans and Specifications unless he has, in writing, specifically called attention to such deviations as the time of submission and has obtained the permission of the Architect/Engineer thereon, nor shall it relieve him from the responsibility for error of any kind in Shop Drawings. When the Contractor does call such deviations to the attention of the Architect/Engineer, he shall state in his letter whether or not such deviations involve any extra cost. If this is not mentioned, it will be assumed that no extra costs are involved for making the change.

D. After receiving approval on the make and type of materials, the Contractor shall order such materials in sufficient time so that no delay or changes will be caused. This is done to facilitate progress on the job and failure on the part of the Contractor shall render him liable to stand the expense of any and all delays occasioned by failure on this part to provide necessary details. All shop drawings shall be delivered to the Architect/Engineer's office within thirty (30) days from the date of the contract.

E. Shop drawings will be returned unchecked unless the following information is included: reference to all pertinent data in the Specifications or on the drawings, size and characteristics of the equipment, name of the project and a space large enough to accept an approval stamp. The data submitted shall reflect the actual equipment performance under the specified conditions and shall not be a copy of the scheduled data on the drawings.
1.7 SUBMITTALS

A. Submittal data shall be organized in commercial quality, three ring binders with durable and cleanable covers. Product information for each piece of equipment shall be separated by an indexing leaf with clear tabs. The product name and symbol (i.e. AHU/Air Handling Unit) shall be typed on white paper inserts and placed in appropriate tab. Complete data must be furnished showing performance, quality and dimensions. A signed review by the Architect/Engineer must be obtained before purchasing any equipment.

B. The following items shall be submitted for review by the Architect/Engineer but are not limited to:

1. Diffusers, Registers and Grilles
2. Fire Dampers
3. Pipe Insulation
4. Duct Insulation
5. Temperature Controls
6. Plenum Materials and Supports
7. Flexible Pipe Connections
8. Heating Terminal Equipment
9. Ductwork Shop Drawings

1.8 QUALITY ASSURANCE

A. General: Comply with Division 1.

B. Welder Qualifications: Welders shall be certified by the American Society of Mechanical Engineers (ASME) National Certified Pipe for the type of work being performed. Current operators' certificates in accordance with ASME standards shall be on file at the site and shall be available to the Architect/Engineer for examination. Coupons shall be available for review by the Architect and Engineer.

C. Locations of all pipes, ducts, outlets, appliance, etc., as shown on the drawings, are approximate only and are understood to be subject to such revisions as may prove necessary or desirable at the time the work is installed. Each Contractor will be required to install his work with relation to existing building conditions and shall be entirely responsible for the correctness of his work with reference to finished elevations, etc. Piping shown on the drawings is diagrammatic only and their exact locations, depths, and invert elevations shall be as required for proper flow and coordination with other trades.

D. The contract drawing depicts graphically the arrangement of piping and ductwork. Should local conditions necessitate a rearrangement, or if any of the piping or ductwork can be installed to better advantage in a different manner, the Contractor shall, before proceeding with the work, prepare and submit three (3) copies of Drawings of the proposed arrangement for the Architect/Engineer's review.

E. If the Contractor proposes to install equipment, including piping and ductwork, requiring space conditions other than those shown, or to rearrange the equipment, he shall assume full responsibility for the rearrangement of the space and shall have the Architect/Engineer review...
the change before proceeding with the work. The request for such change shall be accompanied by Shop Drawings of the space in question.

F. Each Contractor is responsible for the proper location and size of all slots, holes, or openings in the building structure pertaining to his work, and for the correct location of pipe sleeves.

G. Each Contractor shall coordinate his work with that of all other trades that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipe lines which require a stated grade for proper operation. Drainage lines shall take precedence over water lines in determination of elevations. In all cases, lines requiring a stated grade for their proper operation shall have precedence over electrical conduit and ductwork.

H. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Lubricate all equipment properly in accordance with manufacturer's instructions. Furnish Zerk grease fittings on all greaseable bearings.

I. Equipment and Materials: The materials and equipment shall be new and shall be the standard products of the manufacturers regularly engaged in the production of Plumbing, Heating, Cooling, Ventilation, and Fire Protection Equipment, and shall be the manufacturer's latest standard design. Where two or more units of the same class of equipment are required, these units shall be the products of the same manufacturer. However, the component parts of the systems need not be the products of the same manufacturer. Specific equipment specified hereinafter is to be considered a standard of quality and operation. In general, all capacities of equipment, and motor and starter characteristics are shown in schedules on the drawings. Reference shall be made to the schedules for specific information. The capacities shown are minimum capacities. Variations in the characteristics will be permitted only on written approval of the Architect/Engineer. All equipment shall be shipped to the job with not less than a prime coat of paint or as specified hereinafter. Insofar as is possible all items of the same type (i.e., pumps, fans, etc.) shall be by the same manufacturer. Where installation instructions are not included in these specifications or on the plans, the manufacturer's instructions shall be followed. All equipment affected by altitude shall be rated to operate at the altitude where it is to be installed.

J. Excavation and Backfilling: This Contractor shall do all necessary excavation and backfill for the installation of the Mechanical systems as may be required. Curb cuts, asphalt and concrete patching, cutting and patching existing floor, etc., shall be part of this Contractor's responsibility. No extra payment will be made for rock excavation. Trenches for all underground piping shall be excavated to the required depths. The bottoms of trenches shall be tamped hard and graded to secure maximum fall. Bell holes shall be excavated to assure the pipe resting for its entire length on solid ground. Should rock be encountered, it shall be excavated to a depth of 6 inches below the bottom of the pipe, and before laying the pipe, the space between the bottom of the pipe and the rock surface shall be filled with gravel, thoroughly tamped. Pipe laid in trenches dug in fill shall be supported down in the trenches and shall be filled. No roots, rocks or foreign materials of any description shall be used in backfilling the trenches. The backfill material shall be identical to the surrounding fill material and shall be placed in 6-inch layer, wetted, and compacted to the density of the adjacent soil. See Division 2 for additional information for site utilities. All surplus materials shall be hauled from the project by the Contractor at his expense.

K. Cutting and Repairing:

1. Responsibility of the Contractor whose work is involved. Coordinate with others to prevent unnecessary cutting and repairing.
2. Lay out and locate equipment, openings, and chases. Install sleeves, inserts, and supports. Arrange with those whose work is involved to do cutting and replacing caused by negligence or error with costs reimbursed by the Contractor at fault. Cutting and replacing of existing work shall be the responsibility of the Contractor whose work is being installed.

3. Removal or terminating connections of existing work which is abandoned or replaced shall also be done hereunder to provide correct and finished work.

L. Foundations: All equipment shall be provided with suitable foundations and supports. It shall be the responsibility of the Contractor to provide for the proper locations of these foundations and supports. This applies to all rooftop equipment also.

1. All concrete foundations required by equipment furnished by the Mechanical Contractor shall be constructed by them (except where otherwise noted) the conformity with the recommendations of the manufacturer of the respective equipment, and with the approval of the Architect/Engineer. All corners of the foundations shall be neatly chamfered. Foundation bolts shall be placed in the forms when the concrete is poured. Allow 1 inch below the equipment base for alignment, leveling and grouting with non-shrinking grout. Grouting shall be done after the equipment is leveled in place. After the grout has hardened, the foundation bolts shall be pulled up tight and the equipment shimmed, if necessary. After removal of the forms, the surface of the foundation shall be rubbed.

2. Unless otherwise noted, foundations shall be a minimum of 6-inch high. All concrete work performed by these Contractors shall conform entirely to the requirements of the Concrete Specifications which describe this class of work.

M. Code Requirements: Comply with state and local code requirements and ordinances. Call for inspections required by responsible building inspection authority.

N. Applicable Building Codes and Ordinances: Including the latest edition of each code, but not limited to the following:

2. Uniform Mechanical Code.
4. Governing Fire Department Requirements
5. Utility Company Requirements
6. National Fire Protection Association Standards
7. NFPA 70 - National Electrical Code
8. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
9. NEPA 90B - Installation of Warm Air Heating and Air Conditioning Systems
10. NFPA 13 - Sprinkler Systems
11. NFPA 101 - Life Safety
12. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment

O. ACCESS PANELS
1. Similar to Milcor, or as noted on the drawings, size as required for concealed expansion joints, valving, gauges, balancing dampers, valves, traps, pitot stations, equipment and similar items requiring accessibility. Notify the General Contractor of each access panel location and the required size. Panels shall be proper type for ceiling or wall in which they are installed. The panels shall be furnished under this section of the Specifications, unless otherwise directed, but shall be coordinated to be compatible with walls and ceilings furnished under other sections.

1.9 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 1

B. Large Items: Make arrangements with other trades on the job for introduction into the building of equipment too large to pass through finished openings.

C. Acceptance: Check and sign for materials to be furnished by others for installation under all Mechanical Divisions upon delivery. Contractor shall be responsible for the storage and safekeeping of such materials from time of delivery until final acceptance.

D. Protection: Close ends of pipe and ductwork at the close of each working day during construction to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Protect fixtures and equipment against damage during mechanical work with heavy paper or plastic until final clean-up.

E. Storage: Store equipment in covered enclosure or wrap with weather tight 6 mil Visqueen.

F. Shipping Protection: Protective casings, crating, and coverings to remain in place until start-up of equipment.

1.10 PROJECT CONDITIONS

A. Performance: All systems are to be rated at 4,500 ft. elevation.

1.11 SEQUENCING AND SCHEDULING

A. General: Comply with Division 1.

B. Schedule: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.

C. Utility Interruptions: Schedule mechanical utility interruptions with the Architect/Engineer/Owner minimum of seven (7) days prior to the requested outage. Plan work so that duration of the interruptions a maximum of one day.

1.12 CONTROLS WIRING AND ELECTRICAL EQUIPMENT

A. All mechanical equipment controls wiring, conduit, relays, interlocks, and all accessories required for a completely operational controls system shall be the complete responsibility of the mechanical contractor. The mechanical contractor has the option to hire the project electrical contractor or any qualified controls contractor to install mechanical controls wiring and conduit. Refer to Specification Section 253000 for coordination requirements between mechanical, electrical, and controls subcontractors.

B. Electrical items such as disconnect switches and motor starters associated with equipment provided by Division 23, when specifically mentioned to be furnished by the Mechanical Contractor, whether in these specifications or on the Electrical or Mechanical Drawings, shall be
furnished by the Contractor. These items shall be mounted and connected as required for a completely operational system. See Control Systems Specification for further information.

C. All electrical equipment characteristics (voltage, etc.) must be verified by the Contractor prior to ordering. If the Contractor proposes to furnish motors varying in horsepower and/or characteristics from those specified, he shall first inform the Architect/Engineer of the change and shall then coordinate the change with the Electrical Contractor and shall pay all additional charges in connection with the change.

D. All motors shall meet all the requirements of all Electrical Divisions.

1. All motors shall be built in accordance with the current applicable IEEE, ASA, and NEMA standards. All general-purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations. Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. All motors shall have copper windings. All motors to have minimum power factor of 85% or have switched correction to 90%. Unless indicated otherwise, motors shall be NEMA design B with a service factor of 1.15 with 40°C rise and total temperature rise of 65°C ambient and when powered from the system voltage feeding the motor. TEFC motors shall a service factor of 1.00 with total temperature is of 65°C in the above conditions. Motors located in areas exceeding 40°C ambient shall be factory-rated for the ambient temperature of the motor environment. Single phase motors shall generally be NEMA Type N split phase induction motors with built-in thermal protectors. Single phase motors connected on loads requiring high starting torque shall be capacitor-start induction motors. Single phase motors of 1/10 HP or less may be shaded pole induction motors.

1.13 PROTECTION AGAINST HAZARDOUS CONDITIONS

A. The Contractor shall take precautions against hazardous construction conditions at all times during construction. The final condition of the facilities shall be safe, and where safety to operating personnel is jeopardized, suitable signage shall be posted.

B. Protruding metal (bolts, steel angles, etc.) potentially hazardous to maintenance and operating personnel, shall be cut back and/or protected to reduce the risk of injury. All openings between floors shall be protected with barriers around the openings, gratings across the openings, or steel bars through the openings to avoid and protect against injury.

1.14 HAZARDOUS SIGNS

A. Equipment room contains moving or rotating parts, floor openings, or other potentially hazardous environments and shall include a sign on the door entering it that shall read similar to the following: Hazardous Area - Authorized Personnel Only.

1.15 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Mechanical Contractor shall furnish to the Owner a bound (three (3) ring binder) manual in triplicate, containing complete repair parts lists, and operating, service, and maintenance instructions on all mechanical equipment, fixtures, and systems, as noted below:

1. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect/Engineer, Sub-consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

2. For Each Product System: List names, addresses and telephone numbers of Sub-contractors and suppliers, including local source of supplies and replacement parts.
3. **Product Data**: Mark each sheet to clearly identify specific product and component parts, and data applicable to installation. Delete inapplicable information.

4. **Warranties and Bonds**: Bind in copy of each.

5. **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.

6. Include color-coded wiring diagrams as installed for control system.

7. **Operating Procedures**: Include start-up, break-in and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.

8. **Maintenance Requirements**: Include routine procedures and guide for trouble-shooting, disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

9. Provide servicing and lubrication schedule and list of lubricants required.

10. Include manufacturer’s printed operation and maintenance instructions.

11. Include sequence of operation by controls manufacturer.

12. Provide original manufacturer’s part list, illustrations, assembly drawings and diagrams required for maintenance.

13. Provide control diagrams by controls manufacturer as installed.

14. Provide charts of valve tag numbers, with locations and functions of each valve, keyed to flow and control diagrams.

15. Provide list of original manufacturer’s spare parts and recommended quantities and to be maintained in storage.

16. Include Test and Balance (T&B) Reports as specified in Section 230593.

**B. The Mechanical Contractor shall also provide training as required by Section 230100 to the Owner’s operation and maintenance personnel.**

**1.16 OPERATION PRIOR TO ACCEPTANCE**

**A.** The Owner shall have the right to operate any and all apparatus as soon as and as long as it is in operating condition, after Owner personnel have received operational training, whether or not such apparatus has been accepted as complete and satisfactory, except that this shall not be construed to mean operations before any required alterations or repairs have been made. This operation does not indicate acceptance of the equipment by the Owner. When the Contractor enters into a contract with the Owner, he agrees to the above.

**1.17 WARRANTY AND SERVICE PROGRAM**

**A.** Due to the critical performance requirements and to clearly establish warranty responsibility for this project, the Contractor shall provide a full service maintenance and warranty program to the Owner for one full year after beneficial occupancy (substantial completion).

**B.** This service program shall be included as part of the base bid and shall include service, maintenance, repair, replacement, lubrication, temperature control calibration and repairs,
documenting proof for all service and maintenance work on all equipment and system furnished by the Contractor.

C. A single representative in the employment of the Contractor shall be responsible for coordination and follow through of this program. This representative's name and phone number shall be submitted to the Owner as part of the maintenance manuals and supportive data. The Contractor shall respond to a request for service with 24 hours if so requested.

D. During this first year of operation, the following sequence of maintenance service shall be performed as a minimum.

1. Clean strainers in piping.
2. Fans and/or pumps be lubricated and oiled once every four (4) months.
3. Controls shall be calibrated throughout the facility at the end of six (6) months (following substantial completion). Any leaks in the piping systems shall be repaired.
4. All equipment manufacturers’ service recommendations shall be followed during this period.

1.18 FLUSHING AND DRAINING

A. It shall be the responsibility of this Contractor to properly drain and flush all ducts and pipes before use or acceptance to ensure that all debris is completely removed. Damage caused by such debris remaining in the ducts or pipes shall be repaired by this Contractor at his expense. This Contractor shall demonstrate to the Architect/Engineer's representative that all piping is clean.

1.19 CLEANING

A. This Contractor shall remove from the building construction site all rubbish and dirt as it accumulates under the contract. At completion, all areas shall be broom cleaned and all obstructions, surplus materials, etc., removed.

1.20 GUARANTEE

A. The Contractor shall guarantee all materials, equipment, and workmanship furnished and installed by him under this Contract, to be free from all defects of workmanship and materials, and shall agree to replace at his expense, without expense to the Owner, at any time within one year after installation is accepted by the Architect/Engineer, any and all defective equipment, parts, etc., that may be found. (This excludes normal maintenance and daily servicing of equipment which is the Owner's responsibility.)

1.21 FLOOR, WALL, AND CEILING PLATES

A. Where exposed pipes pass through floors, finished walls, or finished ceiling, they shall be fitted with chromium-plated escutcheons of an approved pattern. Escutcheons and plates in Mechanical Rooms do not require chrome finish.

B. This Contractor shall be responsible for providing and installing all counter flashing. All openings in the roof shall be flashed and counterflashed. Use four pound lead flashing materials for all vent lines and welded flashing in steel lines passing through roof. The Mechanical Contractor shall notify the General Contractor where each roof penetrations is and the size of the opening.
1.22 PIPE SLEEVES

A. Schedule 40 steel pipe sleeves or pipe sleeves made of No. 20 gauge galvanized steel, properly secured in place with approximately 1/4" space between each sleeve and the surface of the pipe and/or insulation passing through it, shall be provided for all pipes passing through concrete floors, roofs, and masonry walls. All pipe sleeves shall be fixed in place as the walls and floors are built up. The Contractor shall furnish and locate all sleeves and pipes passing through concrete floors, exterior masonry walls, and roofs shall be made watertight with approved non-hardening plastic material. Sleeves through pipe chase or equipment room floors shall project a minimum of 2-inch above the floor and shall be of black steel pipe with waterproof flange at center of floor thickness. Each sleeve through a fireproof wall shall be packed with approved fireproof rope in the annular space.

1.23 PIPE HANGERS

A. Pipe hangers shall be Fee and Mason of a type suitable for each use. Perforated straps shall not be used in any work. For ferrous pipes up to and including 4 inch in size, use Fee and Mason Fig. 199 malleable iron, adjustable, split ring, swivel hanger. For plumbing piping larger than 4 inch, use Fee and Mason Fig. 239 steel clevis hanger. Where several pipes are parallel at the same elevation, trapeze hangers may be used. Where trapeze hangers are used, the pipes shall be supported on rollers where indicated on the Drawings. For copper pipes up to and including 3 inch in size, use Fee and Mason Fig. 360 malleable iron, copper plated hangers. For copper pipes larger than 3 inch, use Fee and Mason Fig. 364 copper plated clevis hanger.

B. Hanger rod sizes shall conform to the following schedule:
   1. Pipe up to and including 2" 3/8" rods
   2. Pipe 2-1/2", 3" and 3-1/2" 1/2" rods
   3. Pipe 4" and 5" 5/8" rods

C. Unless shown otherwise on the Plans, all horizontal runs of ferrous piping shall be suspended from the floor or roof construction, as the case may be, by means of hangers with the following spacing:
   1. Pipe up to and including 1-1/4" 8'
   2. Pipe 1-1/2" and 2" 10'
   3. Pipe 2-1/2" and 3" 12'
   4. Pipe 3 1/2" and 4” 14’

D. Unless shown otherwise on the Plans, all horizontal runs of copper piping shall be suspended from the floor or roof construction as the case may be, by means of hangers with the following maximum spacing:
   1. Pipe up to 3/4" in size 5'
   2. Pipe 1" and 1-1/4" 6'
   3. Pipe 1-1/2" and larger 10'

E. There shall be a hanger within 2 inch of each elbow or tee. Additional supports shall be provided for valves, strainers, etc. Cast iron pipe shall have not less than one hanger per length of pipe. Vertical risers shall be supported by approved riser clamps at each floor. Vertical pipes within a space shall have not less than two supports.
F. Supports and hangers shall be installed to permit free expansion and contraction in the piping systems. Hangers shall permit vertical adjustment to maintain proper pitch. Where necessary to control expansion and contraction, the piping shall be guided and firmly anchored. No piping shall be self-supporting, nor shall it be supported from equipment connection.

G. Hanger rods for all equipment, pipes, ducts, trapezes, vibration isolators, etc., shall be installed straight, true and plumb. Do not bend or flex hanger rods to accommodate sloping structures, avoid obstacles, or for any other purpose. Where necessary, utilize swivel beam clamps, beveled or swivel hardware, angled, swivel or hinged brackets spanning members or other appropriate means of connection.

H. Expansion bolts shall be Ackerman-Johnson or Hilti.

I. Beam clamps suitable for use with this type of steel construction involved shall be Grinnell.

1.24 PRESSURE VESSEL CERTIFICATION

A. Not used.

1.25 ISOLATION

A. Excessive vibration or objectionable noise created in any part of the building by the operation of any equipment furnished and/or installed under the Mechanical Contract will be extremely objectionable and the Contractor shall take all precautions against the same by isolating the various items of equipment from the building structure and by such other means as may be necessary to eliminate all excessive vibration and objectionable noise produced by any equipment installed by them, and consequently, they shall design all foundations, supports, etc., for their equipment, and all piping with this end in view. In addition, these Contractors shall supervise the construction of all foundations and supports, whether they build them or not, in order that they may be constructed in such a manner as to prevent the transmission of objectionable noise and/or excessive vibration. Submit calculations on all vibration isolation equipment.

B. All equipment having moving parts shall be isolated from the building structure by means of Korfund isolation materials, unless specifically noted otherwise. All isolators shall be the same brand and shall be supplied from the same source. Equipment manufacturer's recommendations shall be followed in the isolation of equipment.

C. Vibration isolators shall have sufficient resilience to meet the following minimum efficiencies:

<table>
<thead>
<tr>
<th>Motor HP</th>
<th>Equipment Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5</td>
<td>90%</td>
</tr>
<tr>
<td>7-1/2 to 15</td>
<td>93%</td>
</tr>
<tr>
<td>20 to 40</td>
<td>95%</td>
</tr>
<tr>
<td>50 to 100</td>
<td>97.5%</td>
</tr>
</tbody>
</table>

D. Spring isolators shall be of the housed type with ribbed pads bonded to the underside of the baseplate, or may be unhoused stable springs. Isolators shall be furnished with snubbers and limit stops where so recommended by the equipment manufacturer.

E. The Supplier of the isolating equipment shall, upon completion of the job, check all isolating materials and verify that they are installed properly, and submit a report in writing to the Architect/Engineer.
1.26 TESTING

A. Before completion of this project, the Mechanical Contractor shall test all materials and equipment which normally require testing. All piping, etc., shall be tested to meet code requirements or the Specification requirements, whichever is more stringent.

B. All equipment shall be operated sufficiently long enough to prove to the Architect/Engineer that the equipment performs satisfactorily and meets the requirements set forth on the Plans or in these Specifications.

1.27 CERTIFICATIONS

A. Before receiving final payment, the contractor shall verify that all equipment furnished and all work done is in compliance with all applicable codes mentioned in these Specifications. Submit certifications and acceptable certificates to the Architect/Engineer.

1.28 GENERAL PIPING INSTALLATION REQUIREMENTS

A. Provisions for Drainage: All piping systems shall be installed so that they may be easily drained. Drain caps, plugs, or hose bibbs shall be installed at low points. Grade piping toward drain locations.

B. Alignment: All installed pipe lines shall be straight and shall remain straight against strains. Proper allowance shall be made for expansion and contraction.

C. Clean as Installed: All piping shall be kept free from scale or loose dirt when installed, and must be kept clean during the completion of the installation. All openings in the piping system shall be capped or plugged while awaiting further connections. All detergents, solvents and other cleaning agents shall be compatible with the materials of fabrication of the system in which they are used. They shall not adversely affect the materials of mechanisms in the systems and they shall be acceptable to equipment manufacturers. All detergents, solvents, and other cleaning agents shall also be compatible with the process streams to be handled by the systems in which they are used.

D. Insulated Fittings: Install between any dissimilar metals such as steel and copper.

E. Expansion and Contraction: The Contractor shall make all necessary provisions for expansion and contraction with proper fittings, anchors, dresser couplings, loops, etc. Install flexible connectors on each pipe at each building expansion joint.

F. Welding: Refer to Paragraph 1.29 of this section of these specifications.

G. Bending: No bending of pipe will be permitted.

H. General: The installation shall be coordinated with respect to space available with heating, cooling, ventilating, and electrical installation. In every instance where there is a conflict in the routing of the piping and the ducting, the routing of the ducting shall govern. Installed piping shall not interfere with the operation or accessibility of doors or windows, shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Cutting or weakening of structural members to facilitate piping, installation is not permitted. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping above ground shall be run parallel with the lines of the building unless otherwise noted on the drawings. Unless otherwise shown on the drawings, horizontal piping shall pitch down in the direction of flow.
with grade of not less than 1 inch in 40 feet. Piping connections to equipment shall be in accordance with details shown on the drawings or as recommended by the equipment manufacturer. Service pipe valves and fittings shall be kept a sufficient distance from other work to permit finished covering not less than 1/2 inch from such other work, and not less than 1/2 inch between finished covering on the different services.

I. Installation of Valves: Valves shall be installed at the locations shown on the drawings and where specified and where directed at site. Gate valves shall be used unless otherwise shown, specified, or directed. All valves shall be installed with their stems horizontal or above. Where tight shutoff is required, a composition seat globe valve or resilient seat ball valve shall be used.

J. All valves which must be used during operation, all control valve assemblies, instrument control cases, liquid level controls, gage glasses, orifices, relief valves, and other equipment which must be observed, adjusted, or serviced during operation shall be located conveniently accessible from an operating platform or grade.

K. In general, relief valves within processing unit limits shall be located conveniently accessible from an operating platform or grade.

1. Those in non-hazardous service, such as water, shall discharge directly to outside.

2. Relief valves should have no piping between the vessel or line and the valve inlet, except as shown on the drawings.

3. Relief valves shall be installed in a vertical position. Vent piping shall be braced and supported in a manner that will not produce excessive stresses in the relief valve and will permit removal of the relief valve without necessary temporary supports for the vent lines.

L. Equipment Connections: All piping connections to pumps and other equipment shall be installed without strain at the pipe connection of the equipment. The contractor shall be required as directed to remove the bolts in flanged connections or disconnect piping to demonstrate that the piping has been so connected. Pipe connections to equipment shall be made with unions or flanged fittings. Provide removable headers for large equipment for service access.

M. Joints

1. Flanged Joints: All flanged joints shall be face matched. Raised face flanges shall not be mated to flat-faced cast-iron flanges on valves or equipment. The raised face must be turned off. All flanged bolt holes shall straddle the horizontal and vertical center line unless otherwise noted.

2. Screwed Joints: Screwed pipe joints shall have American Standard Taper Pipe Threads ANSI-B2.1 Latest Edition. Burrs formed when cutting pipe shall be removed by reaming. Care shall be taken that the inside of pipe is thoroughly clean and free of cutting oil and foreign matter before installation. Joints shall be made perfectly tight by the use of Teflon tape or approved Teflon thread sealing and lubricating compound.

3. Solder-Joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool or wire brush before seating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections. Joints for serrated fittings on water, compressed air below 60 psig, and vacuum lines shall be made with a 95 percent tin and 5 percent antimony. Cored solder or solder containing lead will not be permitted.

N. Reducers: Reduction in pipe size shall be made with one piece reducing fittings. Bushings reducing at least two pipe sizes will be acceptable only when there is no room for reducing couplings or swaged nipples.
O. Unions: All piping unions shall be of the ground joint type constructed from materials equivalent in alloy composition and strength to other fittings specified with which they are used. Union Pressure classes and end connections shall be the same as the fittings used in the lines with the unions. Steel unions shall have hardened stainless steel seating surfaces on both faces.

P. Hanger Supports:
1. All hanger rods used to support piping, conduit, mechanical units, equipment, trapezes and other items shall be straight and installed plumb, regardless of length. Do not bend rods to adapt to sloped or rotated structural members, secondary support members or to sloped mounting holes on supported equipment. Contractor shall utilize available swivel, hinged, or rigid mounting techniques designed to accommodate a slope or rotation, or shall design a custom solution. Selected techniques for each application shall be submitted for approval prior to use.

2. Do not bend rods to circumvent an obstruction.

3. Loads on hanger rods shall be applied in direct tension. Do not apply compression, lateral or moment loads to hanger rods. Install bracing or additional supports to prevent hanger rod from incurring non-tension loading.

4. Do not create offsets in rods; use only in-line couplers, and only when length of coupled rod exceeds standard available length (typically 12 feet), or when full lengths cannot be placed in position. Provide additional horizontal bracing to prevent swaying of supported piping or equipment.

5. Do not straighten bent rods for subsequent use. If a rod becomes bent, cut off and discard the bent portion. Remaining straight portion of rod may be used.

1.29 WELDING

A. All welding of piping covered by this specification, regardless of condition of service shall be accompanied as follows:

1. The welding shall be in accordance with the recommendations of the American Welding Society. Mitering of pipe to form elbows, notching to form these, or any similar construction will not be permitted. Welding fittings shall be installed on all welded lines. Joints to be welded shall be properly aligned and spaced, using special welding clamps where necessary. All welders to be employed shall have passed qualification tests prescribed by the National Certified Pipe Welding bureau (or by another reputable testing laboratory or agency) using procedures approved by the American Society of Mechanical Engineers or the American Welding Society. The welders will be required to pass qualification tests when the work of the welder creates a reasonable doubt as to his proficiency. Tests shall be conducted at no additional expense to the Owner.

2. Each welder shall, in addition to having passed the prescribed qualification tests (as noted in Paragraph 1.30.A.1), prepare sample coupons at the job site on a portion of pipe that is cut such that the cross section of the weld is open to view. The sample weld should be prepared using a 6 inch diameter pipe. The sample shall reflect a continuous weld with perpendicular cut out to show the weld in cross sectional view. This sample, when accepted and approved by a certified welding inspector, shall be used as a standard of quality to compare to other welds that this welder will be performing on the job. This same sample weld will also be a basis for accepting or rejecting the welder for working on this project. The sample weld shall be identified with a date and the welder's name and shall be kept at the site throughout the project.
3. All welding on pressure piping shall conform to all of the requirements of the American Society of Mechanical Engineers Code for Pressure Piping - B31.1 (An American National Standards Institute publication), as defined in the latest edition of the ANSI Power Piping B31.1 Manual. All welding shall also conform to all of the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. All chapters, current addenda and supplements of these manuals shall apply. This code shall be used to establish standards of performance and quality of welds. However, the Owner reserves the right to perform radiographic testing of all welds, to compare any of the welds to the approved "standard" sample welds of each welder, and to compare the welds to the welding diagrams and sketches of those recommended in the ANSI B31.1 Power Piping Manual. The intent is to obtain the highest quality welding job possible. The cost of any initial radiographic testing, for random inspection, shall be paid for by the Owner. If radiographic random testing reveals that a weld is defective, the Contractor shall bear the cost of all repairs and re-testing necessary to be made to subject weld until conformance with radiographic tests is reached. The potential for random radiographic testing and welding quality control applies to all pressure piping systems in this project, including systems below 100 psig. If a question should arise regarding the possibility of faulty welding or if there are obvious visual defects in the welding, the Contractor shall be required to correct such deficiencies to a quality level consistent with the recommendations, welding diagrams and sketches in the ANSI B31.1 Manual. The quality level shall also reflect that of the approved sample welds accomplished by each welder for this particular project.

1.30 TESTING FOR PIPING SYSTEMS

A. General: Before insulation is applied, all piping, equipment, and accessories installed under this contract shall be inspected and tested by the Contractor. All labor, material, and equipment required for testing shall be furnished by the Contractor. The Contractor shall be responsible for all repairs and retesting as required. All instruments and other equipment whose safe pressure range is below that of the test pressure shall be removed from the line or blanked off before applying tests. Prior to performing tests, all lines shall be "blown" free of all loose dirt and foreign particles. The lines shall then be thoroughly flushed with water (liquid lines only) at a sufficient flow rate and period of time, to ensure complete cleaning of the lines of all dirt, scale, and foreign matter. Satisfactory flushing of the lines shall be subject to approval. After testing and flushing lines, all filters and strainers shall be cleaned.

B. Test and Balance shall be by the contractor.

C. Safety: Since the Risk of failure, with the attendant possibility of injury, is appreciable greater with further testing, all safety measures required by codes or ordinance or reasonable applicable to the situation shall be taken.

D. Concealment: Equipment or piping to be pressure tested shall not be insulated, covered, or concealed prior to that test. Compression joint underground piping may be backfilled prior to pressure test except that joints shall remain exposed until after the test, but tie rods, clamps, etc., shall be in place and fastened.

E. Pressure Ratings: These tests shall not be used to establish pressure ratings.

F. System Protection: Protect all piping and equipment against overpressure, collapse from vacuum, and hydraulic shock during the filling, testing and draining procedures. Seats of iron valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Pressure tests against other closed valves shall not exceed twice the normal rating.
Note that where significant differences in elevation exists, there is a risk of overpressure in the lower portions of the system in order to attain test pressure in the upper portion of the system.

G. Test Temperature: Apply test pressure only after the system and test medium are at approximately the same temperature, preferably not less than 60°F. Note that some applicable codes require testing above a specified minimum temperature.

H. Sectionalizing: Systems may be separated into sub-systems for testing if such action will expedite or simplify the testing.

I. Temporary Supports: During hydrostatic testing of lines provide temporary supports to prevent overstressing supports or hangers. When tests are completed, remove all temporary supports, locks, stops, etc., and adjust supports for their cold load and alignment.

J. Testing: Domestic hot and cold water piping and heating water piping shall be tested hydrostatically at the test pressures specified and shall show no drop-in pressure in a 2 hour period. Leaks shall be located by soap testing.

K. Test Report

1. A detailed report of pressure tests on piping and equipment shall be forwarded in duplicate to the Architect/Engineer. This report shall show date of test, lines tested, test medium, length of time test pressure was held, pressure drop or rise, and extent of venting or repressurizing.

1.31 COOPERATION WITH OTHER TRADES

A. The Contractor shall refer to other sections of these specifications covering the work of other trades which must be carried out in conjunction with the mechanical work so that the construction operations can proceed without harm to the Owner from interference, delay or absence of coordination.

1.32 FIELD MEASUREMENTS

A. The Contractor shall verify the dimensions covering the mechanical work at the building. No extra compensation shall be claimed or allowed on account of difference between actual dimensions and those indicated on the drawings. He shall examine the adjoining work on which Mechanical work is dependent for maximum efficiency, and shall report any work which must be corrected. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable work conditions affecting Mechanical work.

1.33 SAFETY GUARDS

A. The Mechanical Contractor shall furnish and install safety guards required in order to obtain certificates of inspection from all authorities having jurisdiction. All belt driven equipment, projecting shafts, and other rotating parts shall be enclosed or adequately guarded. Provide coupling guards on all rotating shafts.

1.34 PROTECTION

A. All work, equipment, and materials shall be protected at all times to prevent obstruction, damage, or breakage. All pipe openings shall be closed with caps or plugs during installation. All equipment shall be covered and protected against dirt, water, chemical, or mechanical injury. At the completion of the work, all equipment shall be thoroughly cleaned and the entire system shall be delivered in a perfect, unblemished condition.
1.35 PAINTING AND IDENTIFICATION

A. All equipment shall be delivered to the job with suitable factory finish. Should the finish be marred in transit or during installation, it shall be finished to present a neat, workmanlike appearance.

B. Except as elsewhere hereinafter specifically required, any painting of equipment, piping, ductwork, grilles, insulation, etc., furnished and installed under this Section of the Specifications will be done by the Painting Contractor. However, the Mechanical Contractor shall leave his equipment clean and free from any grease, dirt, rust, etc., and in suitable condition for painting.

C. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent there being rendered illegible during the painting operation.

D. The piping shall be painted the basic color as indicated in other sections of these specifications and shall be marked every 10 feet on centers with Brady pipe markers. Arrows, approximately 6 inch in length and spaced about 10 feet on centers shall indicate the direction of the flow pipe. Locate additional labels as required in Mechanical Rooms. Staple in place, brush with clear lacquer. Markers shall state pipe size, flow direction, and pipe usage (such as "cold water," etc.).

1.36 RECORD DRAWINGS

A. The Contractor shall, during the execution of the work, maintain a complete set of drawings upon which all dimensional locations of equipment piping and all deviations and/or changes in the work shall be recorded. Water, storm, and drainage mains shall be delivered to the Architect/Engineer in good condition upon the completion and acceptance of the work and before final payment is made.

1.37 SUPPLIER RESPONSIBILITY

A. Each supplier, whether furnishing equipment as specified or as a substitution shall be responsible for certifying that the equipment is properly installed and that the warranty is valid. Submit written reports on the installation and the equipment performance when requested to do so by the Architect/Engineer (or his representative). Each supplier shall be responsible for furnishing qualified personnel at the job site at anytime requested by the Architect/Engineer (or his representative) during the construction or warranty periods.

END OF SECTION 230500
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
A. It is the intent of this specification to define all motors furnished under all sections of the specifications for this project which will provide efficient operation, reliability, ease of maintenance, and repair along with reduced operation costs.
B. All general-purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations. Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. Motors shall be rated explosion-proof when located in hazardous atmospheres.
C. Motors mounted in direct sun shall be provided with a shield to forbid direct radiation from the sun when the sun is 45 degree or greater above the horizon.
D. All supply fan motors mounted in air handling units shall have Class F insulation.
E. Open drip-proof motors shall be NEMA design B with Class B insulation and a 1.15 service factor with 40 degree C ambient and a total temperature rise of 65 degree C.
F. TEFC motors shall be NEMA design B with Class F insulation and a 1.15 service factor with 40 degree C ambient and a total temperature rise of 65 degree C.
G. Severe duty motors shall be NEMA design B with Class F insulation and a 1.15 service factor with 40 degree C ambient and a total temperature rise of 65 degree C.

1.3 GENERAL
A. All motors covered by this specification shall conform to all applicable requirements of NEMA, IEEE, ANSI and NEC Standards. They shall be free from defective material and workmanship and fully capable of performing in accordance with the manufacturer's nameplate rating.
B. Motors shall be approved by Underwriter's Laboratories (UL) for the service specified.
C. Unless otherwise specified, motors shall be suitable for operation in either direction—(CW or CCW) or rotation.
D. Motors shall be Westinghouse II, Reliance XE, Gould E-PLUS, GE Energy Savery, or approved equal.
E. All fractional H.P. motors shall be permanent split capacitor (P.S.C.) with U.L. listed overload protection. The protector shall be calibrated to trip out when the winding reaches a predetermined temperature and automatically reset when the temperature returns to a safe limit.

1.4 EFFICIENCY
A. All motors shall be special high efficiency design. These motors shall be different than manufacturers' standard product, in that losses are reduced by incorporation of design features
including the use of low loss lamination steel, increase in stator/rotor length, increase in copper windings, utilization of high efficiency ventilating fan, computer optimized slot configuration and air gap.

B. All motors shall be all copper wound, high power factor, high efficiency motors. Motor efficiency shall be as determined by IEEE Standard 112A, test method B. Test results shall be submitted to the Engineer.

C. Manufacturer to furnish % efficiency, % PF, amps at Full Load, 3/4 Load, and 1/2 Load with quotation and be prepared to furnish actual test results on individual ratings if required.

PART 2 - PRODUCTS

2.1 GENERAL
A. Motors shall be 60 Hertz voltage as indicated on drawings, Squirrel Cage induction type suitable for across-the-line starting and continuous duty.

B. Motors shall have copper windings.

C. All motors shall be suitable for application without exceeding Class B rise in ambient temperatures up to and including 65 degree C at 1.15 Service Factor. Motor nameplates shall state suitability for 65 degree C ambient application.

D. All motors shall be suitable for application without exceeding Class B temperature rise at altitudes up to and including 9900 feet at a 1.00 Service Factor.

E. Motors shall operate successfully under running conditions at rated load with +10% of rated voltage or +5% of rated frequency or a combined variation in voltage and frequency of +10% (sum of absolute values).

F. Motors will have at least a nominal 85% power factor rating at full load and rated voltage. Exclusion from this requirement are motors which draw less than 1,000 watts at full load and motors with synchronous speeds less than 1800 RPM. Test verification shall be available upon request.

2.2 INSULATION
A. Motors shall have non-hygroscopic Class B or Class F insulation system as required, however, temperature rise shall not exceed Class B rise at rated load per NEMA Standards.

B. The insulation system shall be provided with sufficient treatment so that the completed insulation system will have a minimum resistance of 1.5 megohms after 168 hours of testing to a humidity chamber maintained at 100% relative humidity and 40 degree C ambient.

2.3 TESTS
A. Each motor shall be given a routine factory test per NEMA and ASA Standards to insure compliance with this specification.

2.4 BEARINGS
A. Bearings shall be shielded, regreasable, vacuum degassed steel ball bearings, specially selected for electric motor service and long life expectancy (B-10 MINIMUM).

B. Bearings shall be lubricated with a premium moisture resistant grease formulated to operate over a temperature range of -20 degree F to +300 degree F.
C. Bearing identification by AFBMA number shall be shown on motor nameplate.

2.5 ENCLOSURES
   A. Construction shall be of rugged corrosion resistant metal including a one-piece frame, brackets, conduit box and fan shroud.
   B. Fans shall be bi-directional and constructed of low inertia inert material.

2.6 CONDUIT BOXES
   A. Conduit boxes are to be diagonally split, rotatable in 90 degree turns, gasketed cast iron construction with threaded conduit holes.
   B. Ground lug suitable for grounding motor frame shall be furnished inside of conduit box.
   C. A neoprene lead seal separator gasket shall be mounted between motor frame and conduit box to prevent entry of moisture and dust into the motor.
   D. Conduit box size must meet or exceed minimum as shown in NEC Standards based on motor full load current.

2.7 HARDWARE
   A. Corrosion-resistant cadmium plated grease plugs shall be provided for relubrication of bearings.
   B. An external shaft flinger shall be provided on the shaft to prevent entrance of moisture or dust into the bearings.
   C. All motors Frame 182T and larger shall have lifting eyebolts for lifting the entire motor.
   D. An easy-to-read nameplate shall be provided on each motor and shall include at least the following information:
      1. Horsepower
      2. RPM
      3. NEMA Design
      4. Phase
      5. Hertz
      6. Service Factor
      7. Ambient Temperature
      8. Frame Size
      9. Duty
      10. Class of Insulation
      11. Locked KVA Code
      12. Full Load Amps
      13. Model or Catalog Number
      14. Bearing Identification
15. Guaranteed Minimum Efficiency
16. Nominal Efficiency
17. Voltage

2.8 MOTOR CONSTRUCTION
A. Motors shall be dynamically balanced to limits as indicated below:

<table>
<thead>
<tr>
<th>Speed (Peak-to-Peak)</th>
<th>Maximum Amplitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>3500 &amp; Above</td>
<td>.0010</td>
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<tr>
<td>1700 to 3499</td>
<td>.0015</td>
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<tr>
<td>Less than 1700</td>
<td>.0020</td>
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</tbody>
</table>

2.9 FINISH
A. All external surfaces shall be prime painted with red oxide zinc chromate primer to prevent corrosion.
B. The finish coat of paint shall be a full-gloss epoxy enamel paint. External finish shall protect against moisture and have superior heat resistance to withstand the effects of sunlight and outdoor weathering without chipping or cracking.

2.10 EFFICIENCY
A. Motors furnished shall meet or exceed the efficiency listed on the following Table.
### HIGH EFFICIENCY MOTORS

<table>
<thead>
<tr>
<th>HP</th>
<th>3600 RPM EFFICIENCY</th>
<th>1800 RPM EFFICIENCY</th>
<th>1200 RPM EFFICIENCY</th>
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</thead>
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<tr>
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<td>NOMINAL  MINIMUM</td>
<td>NOMINAL  MINIMUM</td>
<td>NOMINAL  MINIMUM</td>
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<td>88.5    86.5</td>
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<td>90.2    88.5</td>
<td>88.5    86.5</td>
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<td>90.2    88.5</td>
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</tbody>
</table>

END OF SECTION 230513
SECTION 230519 - PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
   A. The Contractor shall furnish and install all piping specialties necessary for satisfactory operation of the systems.
   B. Manual air vents shall be installed at all high points in heating and cooling water piping systems and as shown on the contract drawings.
   C. Valves shall be installed in all primary and secondary plumbing loops and branch lines feeding groups of fixtures in order to isolate such loops and branches without disrupting the service as a whole.
   D. Unions shall be installed where necessary to facilitate maintenance of pumps, valves, regulators and other specialties.
   E. Dielectric unions shall be installed wherever dissimilar metals are joined, except valves in closed loop piping systems.

1.3 RELATED WORK IN OTHER SECTIONS
   220523 - VALVES
   220700 - PIPING INSULATION
   221000 - PIPE AND PIPE FITTINGS
   221113 - DOMESTIC WATER SYSTEMS
   221123 - NATURAL GAS PIPING SYSTEMS
   221313 - SOIL AND WASTE PIPING SYSTEMS
   230000 - HEATING, VENTILATING, AND AIR CONDITIONING INDEX
   230500 - GENERAL HEATING, VENTILATING AND AIR CONDITIONING REQUIREMENTS
   230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 2 - PRODUCTS

2.1 STRainers
   A. Mueller Steam Specialty model 352M cast bronze, threaded ends, y-strainer, 20 mesh stainless steel screens for water service and .033” dia. opening screens for steam service. Provide blow-off valves full size of strainer tapping with drain lines to nearest drain.
B. Mueller Steam Specialty model 752, 250 SWP, flanged for size 2-1/2” and larger with 1/16” dia openings screen for water and 3/64” dia openings stainless steel screen for steam. Provide blow-off valves full size of strainer tapping with drain lines to nearest drain.

2.2 PRESSURE GAUGES

A. Marshalltown “Permagage”, Ashcroft “Duragage”, “Trerice No. 500X, or approved equal. Dials shall be 4-1/2” unless otherwise noted. Proved needle valve for each gauge, and syphon for each steam gauge. Pressure gauges shall be range noted on plans or at mid range of service (as shown on drawings).

2.3 THERMOMETERS

A. Where indicated on the drawings and the piping diagrams, thermometers shall be installed as manufactured by the H.O. Trerice Co., Mueller, Albert Weiss, or approved equal. Thermometers shall be provided with expansion heads so that thermometer will not break under extremes of temperature. Each thermometer shall be provided with a separable socket well which shall be place in the piping system. The well shall be the length required for accurate reading of the thermometer.

2.4 AIR VENTS

A. Manual air vents shall be 1/2” brass ball valves, Nibco No. T-585-70 or approved equal.

2.5 THERMOMETER WELLS

A. Machined brass test wells with screwed caps and chains. H.O. Trerice No. 5573 or 5574 as required, or approved equal.

B. Temperature and Pressure Test Plugs: Furnish pressure and temperature test plugs at all locations as shown on the drawings and at every connection to each piece of equipment. These test plugs shall be furnished with a Nordel valve core and 1/2” NPT brass body complete with gasket cap.

C. Furnish 4 each thermometers and pressure gauges for use by the Owner for checking temperatures and pressures.

2.6 INSULATING UNIONS

A. Insulating unions having a plastic insert for electrical isolation shall be similar to EPCO Sales Company.

PART 3 -EXECUTION

3.1 INSTALLATION

A. All specialties shall be installed in accordance with the best standard practices and as recommended by the manufacturer.

B. Where thermometers or test fittings occur in insulated piping systems or on insulated equipment, extension necks shall be provided to extend beyond the insulation.

C. Dielectric union shall be installed wherever piping of dissimilar metallic material is connected. Insulating unions are not required between bronze valve bodies and connecting steel pipe in closed loop systems such as heating and chilled water systems.

END OF SECTION 230519
SECTION 230593 - BALANCING OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish all labor, materials and equipment required to test and balance the mechanical systems identified on the contract drawings and these specifications, including but not limited to:

1. Testing, adjustment, and balancing of hydronic, air, steam, and refrigerating systems.
2. Measurement of final operating condition of HVAC systems.
3. Sound measurement of equipment operating conditions.
4. Vibration measurement of equipment operating conditions.
5. Adjustment of the mechanical systems shall include but not limited to impellers trimmed, new sheeves and belts to match cfm required, etc. as required to match equipment specified.
6. Operating Test

1.3 RELATED SECTIONS

230000 - HEATING, VENTILATING AND AIR CONDITIONING INDEX
230100 - DEMONSTRATION AND TRAINING
230500 - GENERAL HEATING, VENTILATING, AND AIR CONDITIONING REQUIREMENTS
230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
233000 - AIR DISTRIBUTION
251100 - ELECTRICAL CONTROLS AND INTERLOCKS
253000 - CONTROLS AND INSTRUMENTATION

1.4 REFERENCES

A. The publications listed below form a part of these specifications to the extent referenced. Each publication shall be the latest edition of each except as noted.

1. AABC - National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning System.
2. ADC - Test Code for Grilles, Registers, and Diffusers.
1.5 SUBMITTALS

A. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

B. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

C. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

D. Provide reports in letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

E. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guarantee prior to commencing system balance.

F. Test Reports: Indicate data on AABC National Standards for Total System Balance forms.

G. When test and balancing has been completed, the balancing agency shall prepare a complete report including design and test conditions compared. The report shall be as outlined below.

H. Seven copies of the complete and compiled test data shall be submitted to the Contractor for forwarding to the Architect/Engineer for evaluation and approval.

1. The Report shall be on standard 8-1/2” x 11” good quality paper and bound together to form a complete report. All forms shall be typewritten. Field data may be handwritten on appropriate printed or typewritten forms. Copies of handwritten field notes shall be legible.

2. Each sheet shall have the Building number, name of the Testing Firm, instruments used to perform the tests, name of personnel performing the test, and date test was performed. Date and firm performing the calibration on photometry equipment shall also be included.

3. Outside weather conditions shall be noted during the times the tests were made; cloud cover, temperature, wind speed and direction, precipitation, etc.

I. The Report shall have a T & B Summary section including:

1. Identification of any system or equipment item the Contractor had difficulty balancing to specification or could not be balanced to specification.

2. Identification of any piece of equipment or system whose balance should be rechecked and/or reset during weather conditions different from those present during system balancing.

1.6 PROJECT RECORD DOCUMENTS

A. Record actual locations of flow measuring stations balancing valves and rough setting. Show locations on Test and Balance report reduced size plan drawings.

1.7 QUALITY ASSURANCE

A. Perform total system balance in accordance with NEBB Procedural Standards for Testing, Balancing, and Adjusting of Environmental Systems.
1.8 QUALIFICATIONS
   A. The balancing shall be performed by Energy Balance, Inc., De La Pena LLC, or Kirk Air. Qualified personnel are limited to registered mechanical Engineers and agencies regularly engaged in testing and balancing work. The Contractor shall submit, prior to the start of the balancing work, the qualifications and experience record of the balancing personnel for approval by the Architect/Engineer.
   B. Perform Work under supervision of registered Professional Engineer experienced in performance of this Work and licensed in the state where the Project is located.
   C. The balancing agency shall not be associated with or the same contractor furnishing the controls or instrumentation.

1.9 PRE-BALANCING CONFERENCE
   A. Convene pre-balancing conference one week prior to commencing work of this section in coordination with Architect/Engineer/General Contractor and his Subcontractors.

1.10 SEQUENCING
   A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project. See section 3.1 for pre-balancing inspection.

PART 2 - PRODUCT

2.1 INSTRUMENTS
   A. Instruments in general shall be direct reading. Pressures between 2" W.G. and 12" W.G. shall be measured with manometers. Duct velocities above 600 fpm shall be measured with a pitot tube. Averaging hoods with tight seal shall be used for airflow measurement at diffusers, registers and grilles. RPM shall be measured with a revolution counter and stopwatch. Mercury thermometers are preferred; bi-metallic thermometers may be used if calibration is checked daily. Test report shall list all instruments used and include accuracy and date calibrated. The Contractor shall provide all instruments to make the tests herein specified and required for complete system balancing.

2.2 AIR HANDLERS
   A. After the air system is balanced and an optimum fan speed is selected, the adjustable sheaf or sheaves furnished shall be replaced by the Mechanical Contractor with new non-adjustable sheaves for permanent operation.

2.3 PUMPS
   A. After the water system is balanced and an optimum pump operating point is selected, the pump impeller shall be trimmed to supply the required capacity for pumps over 2 HP, without throttling the flow.
PART 3 - EXECUTION

3.1 EXAMINATION

A. The test and balance agency shall review the plans and specifications prior to installation of the system and submit a report to the Architect/Engineer of any deficiencies in the system which could preclude proper adjusting, balancing and testing of the system.

B. The test and balance agency shall inspect the system prior to adjusting, balancing, and testing work to ensure that all specified components which will affect proper execution of such work are installed and are operating properly. A report shall be submitted to the Architect/Engineer indicating the results of the inspection within three days of the inspection. The following is a partial list of items to be inspected and report provided to the Architect/Engineer.

1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems and control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire/smoke and volume dampers are in place and open. The smoke detectors and power to them is installed and the dampers are operational. Air coil fins are cleaned and combed.
8. Access doors are closed and duct end caps are in place.
9. Air outlets are installed and connected.
10. Duct system leakage is minimized.
11. Hydronic systems are flushed, filled, and vented.
12. Pumps are rotating correctly.
13. Proper strainer baskets are clean and in place.
14. Service and balance valves are open.

C. Submit field reports in a timely manner within one week of pre-balancing conference. Report defects and deficiencies noted during performance of services which prevent system balance.

D. Beginning of work means acceptance of existing conditions of the installed system and equipment on the project.

3.2 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.
3.3 INSTALLATION TOLERANCES
   A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
   B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
   C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING
   A. Ensure recorded data represents actual measured or observed conditions.
   B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
   C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
   D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
   E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.5 AIR SYSTEM PROCEDURE
   A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
   B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
   C. Measure air quantities at air inlets and outlets.
   D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
   E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
   F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
   G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
   H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
   I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
   J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

M. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

N. On fan powered VAV boxes, adjust airflow switches for proper operation.

3.6 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing
   1. Packaged Heating/Cooling Units
   2. Exhaust Fans
   3. Air Handling Units
   4. Fans
   5. Air Filters
   6. Air Terminal Units
   7. Air Inlets and Outlets

B. Report Forms
   1. Title Page
      a) Name of Testing, Adjusting, and Balancing Agency
      b) Address of Testing, Adjusting, and Balancing Agency
      c) Telephone number of Testing, Adjusting, and Balancing Agency
      d) Project name
      e) Project location
      f) Project Architect
      g) Project Engineer
      h) Project Contractor
      i) Project altitude
      j) Report date
   2. Summary Comments
      a) Design versus final performance
      b) Notable characteristics of system
      c) Description of systems operation sequence
d) Summary of outdoor and exhaust flows to indicate amount of building pressurization

e) Nomenclature used throughout report

f) Test conditions, including weather conditions

3. Instrument List:
   a) Instrument
   b) Manufacturer
   c) Model number
   d) Serial number
   e) Range
   f) Calibration date

4. Electric Motors:
   a) Manufacturer
   b) Model/Frame
   c) HP/BHP
   d) Phase, voltage, amperage; nameplate, actual, no load
   e) RPM
   f) Service factor
   g) Starter size, rating, heater elements
   h) Sheave Make/Size/Bore

5. V-Belt Drive:
   a) Identification/location
   b) Required driven RPM
   c) Driven sheave, diameter and RPM
   d) Belt, size and quantity
   e) Motor sheave diameter and RPM
   f) Center to center distance, maximum, minimum, and actual

6. Pump Data:
   a) Identification/number
   b) Manufacturer
   c) Size/model
   d) Impeller
   e) Service
f) Design flow rate, pressure drop, BHP  
g) Actual flow rate, pressure drop, BHP  
h) Discharge pressure  
i) Suction pressure  
j) Total operating head pressure  
k) Shut off, discharge and suction pressures  
l) Shut off, total head pressure  

7. Gas Fired Equipment  
a) Manufacturer  
b) Model number  
c) Serial number  
d) Firing rate  
e) Overfire draft  
f) BTUH at sea level  
g) BTUH at altitude  
h) Gas pressure at meter outlet  
i) Gas flow rate in cfh  
j) Heat input  
k) Burner manifold gas pressure  
l) Orifice size  
m) Air temperature rise for gas fired equipment  
n) Check all limit devices for proper operation, setting and calibration  
o) Make up water pressure setting  
p) Working pressure  
q) Ambient temperature  
r) Relief valve setting  
s) Static pressure  
t) Fan hydronic system and fan cfm  
u) Heat output  

8. Air Moving Equipment  
a) Location  
b) Manufacturer  
c) Model number
d) Serial number
e) Arrangement/Class/Discharge
f) Air flow, specified and actual
g) Return air flow, specified and actual
h) Outside air flow, specified and actual
i) Total static pressure (total external), specified and actual
j) Inlet pressure
k) Discharge pressure
l) Sheave Make/Size/Bore
m) Number of Belts/Make/Size
n) Fan RPM

d) Serial number

9. Return Air/Outside Air Data:
a) Identification/location
b) Design air flow
c) Actual air flow
d) Design return air flow
e) Actual return air flow
f) Design outside air flow
g) Actual outside air flow
h) Return air temperature
i) Outside air temperature
j) Required mixed air temperature
k) Actual mixed air temperature
l) Design outside/return air ratio
m) Actual outside/return air ratio

10. Exhaust Fan Data:
a) Location
b) Manufacturer
c) Model number
d) Serial number
e) Air flow, specified and actual
f) Total static pressure (total external), specified and actual
g) Inlet pressure
h) Discharge pressure
i) Sheave Make/Size/Bore
j) Number of Belts/Make/Size
k) Fan RPM

11. Duct Traverse:
   a) System zone/branch
   b) Duct size
   c) Area
   d) Design velocity
   e) Design air flow
   f) Test velocity
   g) Test air flow
   h) Duct static pressure
   i) Air temperature
   j) Air correction factor

12. Duct Leak Test:
   a) Description of ductwork under test
   b) Duct design operating pressure
   c) Duct design test static pressure
   d) Duct capacity, air flow
   e) Maximum allowable leakage duct capacity times leak factor
   f) Test apparatus
      1) Blower
      2) Orifice, tube size
      3) Orifice size
      4) Calibrated
   g) Test static pressure
   h) Test orifice differential pressure
   i) Leakage

13. Air Distribution Test Sheet:
   a) Air terminal number
   b) Room number/location
   c) Terminal type
d) Terminal size

e) Area factor

f) Design velocity

g) Design air flow

h) Test (final) velocity

i) Test (final) air flow

j) Percent of design air flow

14. Sound Level Report:

a) Location

b) Octave bands - equipment off

c) Octave bands - equipment on

15. Vibration Test:

a) Location of points:
   1) Fan bearing, drive end
   2) Fan bearing, opposite end
   3) Motor bearing, center (if applicable)
   4) Motor bearing, drive end
   5) Motor bearing, opposite end
   6) Casing (bottom or top)
   7) Duct after flexible connection (discharge)
   8) Duct after flexible connection (suction)

b) Test readings:
   1) Horizontal, velocity and displacement
   2) Vertical, velocity and displacement
   3) Axial, velocity and displacement

c) Normally acceptable readings, velocity and acceleration

d) Unusual conditions at time of test

e) Vibration source (if non-complying)

3.7 CALCULATIONS

A. The following calculations shall be made and become part of the reported data.

1. The CFM at each heating, cooling, and units, the heating and/or cooling capacity of each and the air temperature change of each.
2. The capacity of each refrigeration unit in BTUH or tons at full capacity and at each unloaded step.

3.8 OPERATING TEST

A. The test and balance agency shall coordinate and set up an operating test when Test & Balance is completed to ensure complete operation of the system in all modes. The controls contractor, sheet metal trade and the general contractor shall certify in writing test completion and all units are operating as designed. Attach copy of operating test to Test & Balance report.

END OF SECTION 230593
SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY
A. Furnish and Install
   1. Ductwork insulation.
   2. Duct liner.
   3. Insulation jackets.

1.2 RELATED DOCUMENTS
A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.3 DESCRIPTION OF WORK
A. Work Included: The work included by this specification consists of furnishing all labor, accessories, equipment and materials necessary for the installation of all insulation for ductwork and mechanical equipment in accordance with the specification and applicable drawings. This includes but is not limited to:
   1. All supply ductwork.
   2. Return ductwork not within the conditioned space.
   3. All ductwork in the mechanical room.
   4. Outside air inlet ductwork that is within the conditioned space.
   5. Mechanical equipment not factory insulated.
B. Do not internally insulate ductwork from evaporative coolers unless specifically indicated on the drawings.
C. Exterior duct wrap insulation with vapor barrier shall be used on all outdoor air ductwork within conditioned spaces.
D. Supply and return air ductwork shall be insulated with duct liner except in air handling systems having air washers or humidifiers. Where air washers or humidifiers are used, exterior duct insulation shall be used. Where duct liner is used, dimensions shown on the drawings shall be clear inside duct liner.
E. Testing:
   1. All ductwork and mechanical equipment shall be tested for leakage and approved by the Architect/Engineer before any insulation is applied. The insulation contractor shall have this verified in writing before beginning work.

1.4 RELATED WORK IN OTHER SECTIONS
   099000 - PAINTING: PAINTING INSULATION JACKETS.
   230000 - HEATING, VENTILATING, AND AIR CONDITIONING INDEX.
230500 - GENERAL HEATING, VENTILATING, AND AIR CONDITIONING REQUIREMENTS

230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

233000 - AIR DISTRIBUTION

1.5 REFERENCES

A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
C. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
D. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
E. ASTM E84 - Surface Burning Characteristics of Building Materials.
I. UL 723 - Surface Burning Characteristics of Building Materials

1.6 DEFINITIONS

A. Exposed Location: Exposed in mechanical rooms or rooms with finished walls or ceilings.
B. Concealed Location: Located in pipe chase, furred spaces, attics, crawl spaces, above suspended ceilings in finished and unfinished rooms, or all other locations not exposed to view.
C. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
D. K Factors: All K Factors shown in the following specifications are expressed in BTU-in/hr-sq.ft-F.

1.7 SUBMITTALS

A. General: Comply with Section 230500.
B. Product Data: Provide product description, list of materials and thickness for each service, and locations.
C. Manufacturer's Installation Instructions: Indicate procedures, which ensure acceptable workmanship and installation standards will be achieved.

1.8 QUALITY ASSURANCE

A. Regulatory Requirements Fire Hazard Classification: Insulation shall have a composite (insulation, jacket or facing, and adhesive to secure jacket or facing) fire hazard rating as tested by ASTM E84, NFPA 255, or UL 723 not to exceed 25 flame spread, 50 fuel contribution, and 50 smoke development. Materials shall be labeled accordingly.
B. Certifications of Insulation and Covering Materials: UL listed; flame spread/fuel contributed/smoke development rating of 25/50 in accordance with ASTM E84, NFPA 255, and UL 723.
1.9 QUALIFICATIONS
   A. Applicator: Company specializing in performing the work of this section with minimum five years of documented experience.

1.10 DELIVERY, STORAGE AND HANDLING
   A. General Requirements: Comply with Section 230500. Deliver materials to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness. Store in a warm, dry location and protect against dirt, water, chemical, and mechanical damage.

1.11 PROJECT CONDITIONS
   A. Manufacturer's Requirements: Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation while in storage.
   B. Environmental Requirements: Perform work at ambient and equipment temperatures as recommended by the insulation manufacturer.
   C. Protection: Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Repair or replace any such insulation or covering damaged prior to final acceptance of work.

1.12 WARRANTY
   A. General: Satisfy requirements of Section 230500.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Acceptable Manufacturers:
      1. Owens-Corning Fiberglass Corporation.
      2. Knauf.
      3. Certainteed.

2.2 INSULATION MATERIALS
   A. Glass Fiber, Flexible:
      1. Insulation: ASTM C-553; flexible, noncombustible blanket.
         a) 'K' value: ASTM C518, of 0.29 at 75 degrees F.
         b) Maximum service temperature: 250 degrees F.
         c) Maximum moisture absorption: 0.20 percent by volume.
         d) Density: 0.75 lb/cu ft.
      2. Vapor Barrier Tape:
         a) Kraft paper reinforced with glass fiber yarn and bonded to aluminum film.
      3. Tie Wire: Annealed steel, 16 gage.
   B. Glass Fiber, Rigid:
1. Insulation: ASTM C612; rigid, noncombustible blanket.
   a) 'K' value: ASTM C518, of 0.29 at 75 degrees F.
   b) Maximum service temperature: 250 degrees F.
   c) Maximum moisture abortion: 0.20 percent by volume.
   d) Density: 0.75 lb/cu ft.

2. Vapor Barrier Jacket:
   a) Kraft paper reinforced with glass fiber yarn and bonded to aluminum film.
   b) Moisture vapor Transmission: ASTM E96; 0.04 perm.
   c) Secure with pressure sensitive tape.

3. Vapor Barrier Tape:
   a) Kraft paper reinforced with glass fiber yarn and bonded to aluminum film, with pressure sensitive rubber based adhesive.

C. Glass Fiber Duct Liner, Flexible
   1. Insulation: ASTM C-553; flexible, noncombustible blanket.
      a) 'K' value: ASTM C518, of 0.28 at 75 degrees F.
      b) Maximum service temperature: 250 degrees F.
      c) Density: 2.0 lb/cu ft.
      d) Maximum Velocity on Coated Air Side: 4000 ft/min.
   2. Adhesive
      a) Waterproof, fire-retardant type.

D. Glass Fiber Duct Liner, Rigid:
   1. Insulation: ASTM C-612; flexible, noncombustible.
      a) 'K' value: ASTM C518, of 0.23 at 75 degrees F.
      b) Maximum service temperature: 250 degrees F.
      c) Density: 2.0 lb/cu ft.
      d) Maximum Velocity on Coated Air Side: 4000 ft/min.
   2. Adhesive:
      a) Waterproof, fire-retardant, type.

2.3 JACKETS
A. Canvas Jackets: UL listed.
   1. Fabric: 6 oz/sq yd, plain weave cotton treated with dilute fire retardant lagging adhesive.
2. Lagging Adhesive: Compatible with insulation.

   1. Thickness: 0.025-inch sheet.
   2. Finish: Smooth or Corrugated.
   4. Fittings: 0.016-inch thick die shaped fittings covers with factory attached protective liner.
   5. Metal Jacket Bands: 3/8-inch wide, 0.016-inch thick aluminum.
   6. Flexible glass fiber with fire resistant coating facing air stream; ASTM E-84/ASTM C518-70; 'k' value of 0.25 maximum at 75 F, 2 lb. density, one-inch thickness.

C. Type C: Neoprene faced, rigid glass fiberboard, 2 lb. density, ASTM E-84/ASTM C-518; 'k' value of 0.23 at 75 F; one-inch thickness.

D. Jackets:
   1. Interior Applications
      a) Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.
   2. Exterior Applications
      a) Sheet metal enclosure of corrugated aluminum, 0.02 in. thick, with metal jacket bands: 3/8 inch wide, 0.016 thick aluminum; or stick clips with smooth finish.

2.4 ACCESSORIES
   A. Impale Anchors: Galvanized steel, 12 gage, self-adhesive pad and press on washer head.
   B. Joint Tape: Glass fiber cloth, open mesh.
   C. Lagging Adhesive: Fire resistive to ASTM E-84 or NFPA 255 or UL 723.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify that ductwork has been tested before applying insulation materials.
   B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION
   A. General
      1. Applications: Apply insulation tightly over clean, dry surfaces with sections or edges firmly butted together or lapped. Make insulation continuous through sleeves or openings in walls or floors.
      2. Vapor Barriers: Seal vapor barriers and run continuous throughout for heated and cooled supply air ductwork.
3. Finishes: Finish insulation neatly at hangers, supports and other protrusions. Locate insulation or cover seams in least visible locations.

4. Installation Repairs: Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.

5. Exterior Locations: Re-cover with corrugated aluminum jacket attached with suitable aluminum rivets.

6. Manufacturer's Instructions: Install materials in accordance with manufacturer's instructions.

7. Thermal Units: Provide insulation with vapor barrier on ductwork downstream of fan coil terminal units.

8. Factory Insulated Equipment: Do not insulate factory-insulated equipment.

9. Attachment: Apply insulation as close as possible to equipment by grooving, scoring, and bevelling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands.


11. Placards: Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such nameplate or any operable device.

12. Service Access: When equipment with insulation requires periodical opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage.

13. Insulation shall be installed in a workmanlike manner by workmen regularly engaged in this type of work. Insulation shall not be applied until all surfaces are clean and dry and until inspection and release for insulation application.

14. A complete moisture and vapor seal shall be provided on cold surfaces where vapor barrier jackets or coatings are required. Anchors, hangers and other projections shall be insulated and vapor sealed to prevent condensation.

15. Duct insulation shall be continuous through walls and floor openings except where walls or floors are required to be fire stopped or required to have a fire resistance ratings.

B. Locations for Insulation:

1. External: Outside of ducts not internally lined, located interior of building, in mechanical room.
   a) Rectangular: 1-1/2-inch thick glass fiber insulation. Fasten to duct with weld pins or stock clips spaced 12 inches to 18 inches o.c. with minimum of two rows per side of duct. Secure with washers firmly embedded in insulation. Seal joints, breaks and punctures in cold air ductwork wire fire-retardant vapor adhesive reinforced with a three-inch wide strip similar to that of facing.

   b) Round: Two-inches thick glass fiber blanket duct wrap. Adhere insulation to duct with fire retardant adhesive applied in bands around the duct. Butt tight with facing overlapping all joints at least two inches. Seal cold air ductwork with fire...
retardant vapor barrier adhesive. Seal breaks and punctures in the facing of cold air ductwork with vapor barrier tape sealed with fire retardant adhesive.

2. For exterior applications, provide insulation with vapor barrier jacket w/2” thick rigid insulation w/minimum R-value of 8. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.

3. Insulation below grade shall be polyurethane spray foam, suitable for use in wet environments without degradation and having the following properties.
   a) All duct shall be supported on 2” thick rigid polystyrene board exceeding the width of the duct. Spray foam shall be applied to assure a 2” MINIMUM coverage. Insulation shall be coated with Deer-O Foam Cap W-256 applied at the rate of one gallon per 100 square ft. for vapor barrier protection with a perm rating of 0.00019.

C. Duct Liner
   1. Duct liner shall be installed in accordance with Figures 6-1 through 607 of the SMACNA High Velocity Duct Manual and the Manufacturer’s recommendations.

END OF SECTION 230713
SECTION 233000 - AIR DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
A. Furnish and install fans, filters, sheet metal work, grilles, louvers, diffusers, registers, sound traps, special fan bases, fire dampers, combination fire and smoke dampers and sleeves, accessories and natural gas fired appliance flue vents.
B. All automatically controlled dampers furnished under Section 253000 - CONTROLS AND INSTRUMENTATION will be installed under this section. After dampers are set they shall be balanced for free and easy operation.
C. Where ductwork has an interior lining, dimensions shown on drawings shall be clear dimensions inside the liner.
D. Prior to system test and balance, supply and install new, clean air filters throughout the air handling systems except for any high efficiency filters, which have pressure drop within normal operating limits.

1.3 REQUIREMENTS AND RELATED WORK
230000 - HEATING, VENTILATING, AND AIR CONDITIONING INDEX
230100 - DEMONSTRATION AND TRAINING
230500 - GENERAL HEATING, VENTILATING AND AIR CONDITIONING REQUIREMENTS
230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230519 - PIPING SPECIALTIES
230593 - BALANCING OF MECHANICAL SYSTEMS
230713 - DUCT INSULATION
253000 - CONTROLS AND INSTRUMENTATION

1.4 REFERENCES
A. ASTM A 36 - Structural Steel
B. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
C. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
D. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality
E. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
F. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
G. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality
H. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled
I. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality
J. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate
K. AWS D9.1 - Welding of Sheet Metal
N. NFPA 91 - Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying - Latest Edition
P. SMACNA - HVAC Air Duct Leakage Test Manual
Q. SMACNA - HVAC Duct Construction Standards - Metal and Flexible - 1985
R. UL STANDARD 181 - Factory-Made Air Ducts and Connectors
S. UL STANDARD 555 – Standard for Safety Fire Dampers
T. UL STANDARD 555S – Leakage Rated Dampers for use in Smoke Control Systems

PART 2 - PRODUCTS

2.1 EQUIPMENT SCHEDULES
A. All major items of equipment are specified in the equipment schedule on the drawings and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory operating system.
B. All registers, grilles and diffusers shall be as listed in the schedule on the drawings. Frame style shall be coordinated by the Contractor to match the ceiling type shown on the reflected ceiling plans of the Contract Documents.

2.2 DUCTWORK
A. SHEET METAL
   1. Materials and Gauges: Construct all ducts, casings, plenums, etc., of galvanized steel sheets, of the gauges specified below, unless otherwise shown. Sheets shall be free from blisters, slivers, pits and imperfectly galvanized spots.
   2. All ductwork shall be constructed in accordance with "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE". First Edition, 1985 as published by Sheet Metal and Air Conditioning Contractors National Association, Inc. Pressure class for all ductwork shall be 2” or unless otherwise noted on plans.
3. Construct low velocity ducts using Pittsburgh or "Snap-Lock" corner seams. All seams shall be made airtight. Using United Mc Grill “UNI-FLEX” duct sealer or approved equal.

4. Connections of high pressure and/or velocity ducts, fittings and high pressure boxes shall be made airtight by tack welding on 8" centers and coating joints with United Mc Grill “United duct Sealer”.

5. Round ducts and fittings for high velocity systems shall be spiral lock seam conduit as manufactured by United McGill Co., Inc., or approved equal. All 90 elbows shall be at least 5-piece construction. Standard manufactured ducts of other than spiral construction will be acceptable if constructed of the following gauges with welded seams. Sizes thru 12-inch diameter shall be 22 gauge, 13 inch thru 36 inch diameter shall be 20 gauge, 37 inches and over shall be 18 gauge. Basic high velocity fittings are detailed on the drawings. Spun or tapered takeoffs shall be used from all vertical high velocity risers.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 time’s width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible, maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

D. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4-inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

E. Provide standard 45-degree lateral wye takeoffs unless otherwise indicated where 90-degree conical tee connections may be used.

F. FLEXIBLE

1. Flexible ducts for connections between rigid ductwork and variable volume boxes shall be Factory Insulated flexible conduit capable of holding 5 inches W.C. without development leaks and shall not exceed a flame spread of 25 or a smoke development of 50. Thermo flex Type N-KH or approved equal.

2. Flexible connections between the diffusers and the run out ducts shall be factory insulated, sound absorbing low velocity flexible conduit conforming to the following duct fabrication shall not exceed a flame spread of 25 or a smoke development of 50.
   a) Two ply vinyl film supported by helically wound spring steel wire: fiberglass insulation: polyethylene vapor barrier film.
   b) Pressure Rating: 10 inches WG (2.50 kPa) positive and 1.0 inches WG (250 Pa) negative.
   c) Maximum Velocity: 4000 fpm (20.3 m/sec).
   d) Temperature Range: -10 degrees F to 160 degrees F (-23 degrees C to 71 degrees C).
2.3 COMBINATION FIRE/SMOKE DAMPERS

A. Furnish and install at locations shown on plans, or as required by code combination fire/smoke dampers meeting the following specifications. Frame shall be galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement.

B. Each combination fire smoke damper shall be 1-1/2 hour fire rated under UL Standard 555 or greater where noted on architectural plans, and bear a UL label attesting to same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. The leakage rating under UL555S shall be Leakage Class II (10 cfm/ft. at 1” w.g.)

C. In addition to the leakage ratings already specified herein, the dampers and their actuators shall be qualified under UL555S to an elevated temperature of 250º F, 350ºF, or 450ºF depending upon the actuator. Appropriate electric “Firestat” operator shall be installed by the damper manufacturer at time of damper fabrication. Damper and actuator shall be supplied as a single entity which meets all applicable UL555 and UL555S qualifications for both dampers and actuators. Manufacturer shall provide factory assembled sleeve of 16” minimum length (contractor to verify requirement). Factory supplied caulked sleeve shall be 16 gage for dampers up to 36” wide by 24” tall and 14 gage above 36” wide X 24” tall.

1. Combination Fire/Smoke dampers shall be Ruskin FSD60 rectangular dampers and Ruskin FSDR25 for round dampers or approved equal with correct mounting frames and sleeves for actual installation.

2. Combination Fire/Smoke dampers for corridors ceiling shall be Ruskin FSD36 with internally mounted actuator.

D. Each combination fire and smoke damper shall include an integral factory furnished and installed duct smoke detector compatible with the building fire alarm system. Assembly by Ruskin DSDN or approved equal.

E. Size of access doors in ductwork shall be 2 inches less than the width of the duct by 12 inches, up to a maximum size of 24 inches by 24 inches.

2.4 FIRE DAMPERS

A. Furnish and install at locations shown on the drawings or as required by code fire dampers meeting the following requirements. Provide access doors at all fire damper locations of sufficient size to allow easy resetting of fire damper linkage. Fire damper links shall be of the test strength recommended to prevent nuisance closing. All fire dampers shall conform to the requirements of NFPA Pamphlet 90A and shall meet the required UL Standard 555.

B. High Velocity Round or Oval Fire Dampers: High velocity fire dampers shall be of the folding blade type designed for minimum static pressure drop. Fusible links shall be accessible from either side of the damper. Each damper shall be furnished complete with a galvanized welded steel sleeve (round or oval) and closure compartment to house the folded blades. Fire dampers shall be Ruskin FD35 with 165ºF fusible link or approved equal.

C. Rectangular Fire Dampers: Fire dampers for rectangular ductwork shall be of the folding blade type with the hinged blades completely out of the air stream of the single hinged blade type. Fusible links shall be accessible from either side of the damper. Each damper shall have a galvanized welded steel sleeve (rectangular or square) and closure compartment to house the folded blades. Rectangular fire dampers mounted in the horizontal plane are to be spring loaded. Fire dampers shall be Ruskin DIBD with 165ºF fusible link or approved equal.
D. Provide access doors at all fire damper locations of sufficient size to allow easy resetting of fire damper linkage. Size of access doors in ductwork shall be 2 inches less than the width of the duct by 12 inches, up to a maximum size of 24 inches by 24 inches.

E. Each fire damper shall be provided with spare fusible link(s) secured to the damper.

2.5 ACCESS DOORS

A. Wall and Ceiling Access Doors: Furnish as required in Section 230500, paragraph 3.6.

B. Duct Access Doors: Duct access doors at fire dampers and other locations which require access to mechanical devices inside of ductwork shall be Controlair 16 gauge access door with continuous hinge, neoprene gasket, thumb screw locks and baked enamel finish. Doors shall be sized for easy access to mechanical device.

C. Doorframes on insulated ductwork shall be placed on an extended metal collar flush with the face of the finished insulation.

D. Latches shall be operable from either side of door and shall be "Ventlok" No. 310.

2.6 BURIED UNDERGROUND DUCTS

A. Buried ducts may be concrete encased sheet metal PVC jacketed sheet metal as indicated.

B. Fabricate metal ductwork in accordance with SMACNA Low Pressure Duct Construction Standards, except as indicated. Fabricate using two gages heavier material than indicated for 2-inch WG pressure class.

2.7 FILTERS

A. Filters shall be as listed in the schedule on the drawings.

B. Filter gauge for each bank of filters in the mechanical rooms and roof top equipment will be supplied and installed by the Controls Contractor as specified in Section 253000 - CONTROLS AND INSTRUMENTATION.

2.8 COILS

A. In no case shall specified air or water pressure drops be exceeded more than 10%. Piping connections shall be as shown on the drawings. Coils shall be as specified in the equipment schedule on the drawings. In no case shall rows or fin spacing be less than the minimum surface scheduled.

2.9 TURNING VANES

A. Turning vanes shall be installed in all square elbows. Turning Vanes shall be air foil blade type, shop or factory fabricated.

2.10 FLUE GAS VENTS

A. Gas fired equipment shall be vented in accordance with the Uniform Mechanical Code, Uniform Plumbing Code and local codes and ordinances. Natural draft appliances shall have Type “B” vents.

PART 3 - EXECUTION

3.1 INSTALLATION OF SHEET METAL WORK

A. All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may
be required. Whenever this is necessary the required area shall be maintained. All of these changes, however, must be approved and installed as directed at the project. During the installation, the open ends of ducts shall be protected to prevent debris and dirt from entering. Whenever exposed ducts pass through walls, floors or ceilings, a flanged sheet metal collar fitting close around ducts shall be slipped along duct until flange is tight against finished surface covering edges of openings and presenting a neat appearance. Collar shall be locked to duct.

B. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

C. Use double nuts and lock washers on threaded rod supports.

D. Connect diffusers or light troffer boots to low-pressure ducts with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.

E. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.

F. Encase buried metal ductwork in 3-inch minimum of concrete. Provide adequate tie-down points to prevent ducts from floating during concrete placement. Introduce no heat into ducts for 20 days following placement of concrete.

G. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

H. All ducts, coils, housings, registers, grilles, fans, etc., shall be clean when installed and shall be kept clean until the system is completed. As the various parts of the system are installed they shall be wiped or blown clean and openings taped dust-tight with heavy paper or cardboard until the system is completed and ready for testing. At that time all covers and protective wrappings shall be removed. Where one has been torn or previously removed, the duct, coil, register, etc., shall be carefully cleaned of any dirt or dust that has entered the opening.

3.2 DUCTS AT MASONRY

A. Where ducts are shown connecting to masonry openings and along edges of all plenums at floors and walls, provide a continuous 2" x 2" x 1/8" galvanized angle iron which shall be bolted to the construction and made airtight to the same by applying caulkng compound. Sheet metal in these locations shall be bolted to the angle iron.

3.3 HAND AND SPLITTER DAMPERS

A. Install hand operated volume and splitter dampers at all locations of branches of main ducts, from equipment, supply ducts, return ducts and at all locations where air flow splits or is balanced, whether shown or not. Volume dampers shall be controlled by heavy duty locking quadrants mounted on the outside of the duct. Where ducts are insulated the damper rod shall be extended and the operator shall be mounted on the outside of the insulation. Where volume dampers are installed in ducts over 12" deep, the dampers shall be made in two sections and each independently operated. Splitter dampers shall be at least 1 1/2 times as long as the narrowest adjacent split. All damper fittings must be heavy commercial items and must be approved by the Architect/Engineer before installation.
3.4 FLEXIBLE CONNECTIONS
   A. Provide glass fabric, neoprene coated flexible connections, not less than 6" wide at the inlet and outlet connection of each fan unit, securely fastened to the unit and to the ductwork. Material shall comply with Underwriter's Laboratories Standard 214.
   B. Indoor applications shall have Metaledge Ventglas with heavy glass fabric, double coated with Dupont's Neoprene.
   C. Outdoor applications shall have Metaledge Ventlon with heavy glass fabric, double coated with Dupont's Hypalon.

3.5 CROSS BREAKING
   A. Rectangular sheet metal ducts shall be cross-broken on the four sides of each 4-foot panel. All vertical and horizontal sheet metal barriers, duct offsets, elbows, as well as 4-foot panels of straight sections of ducts shall be cross-broken. Cross breaking shall be applied to the sheet metal between the standing seams or reinforcing angles. The center of the cross break shall be of the required height to assure surfaces being rigid. High velocity plenum panels and ductwork shall not be cross-broken.

3.6 TEST HOLES IN DUCTWORK
   A. Furnish test holes in ducts at locations required by the testing and balancing team for testing of air quantities in ducts. Ventlok No. 699, closures shall be provided and installed for each test hole, with sufficient neck length to penetrate the insulation.

3.7 HANGERS AND SUPPORTS
   A. Hangers for ducts up to 18 inches in width or diameter shall be placed not more than ten-foot centers. Ducts 19 inches and over in width or diameter shall be supported on not more than five foot centers. Hangers shall be placed plumb and present for a neat appearance. Construct hangers for high velocity boxes and for ductwork form galvanized iron 1" x 1" x 1/16" for ducts up to 36 inches in width or diameter. For ducts over 36 inches in width or diameter, support ducts every 4'-0" with 1 1/4" x 1 1/2" x 1/8" angles. The use of perforated band iron for duct support is prohibited. Hangers shall extend down the sides of the ducts using not less than three rivets or parker screws of appropriate sizes. It is essential that all ducts be rigidly supported. Where vertical ducts pass thru floors or roofs heavy supporting angles shall be attached to ducts and to the structure. Angles shall be of sufficient size to support ductwork rigidly. Place supporting angles on at least two sides of the duct.

3.8 FABRICATION
   A. All ductwork shall be fabricated with the mill markings on the outside.

3.9 TESTS
   A. Testing and balancing of the air tempering systems will be as specified in Section 230593 - BALANCING OF MECHANICAL SYSTEMS.
   B. If specified conditions cannot be obtained due to deficiencies in equipment performance or improper installation or workmanship, the Mechanical Contractor shall make any changes necessary to provide the specified conditions.
   C. Cleaning ducts and testing for tightness: Before the ceiling is installed and final connections are made to air outlet devices, operate the fans at full capacity to blow out dirt and debris from the ducts. If it is not practical to use the main supply blower for cleaning, the ducts may be...
blown out in sections by a portable fan. After the ducts have been cleaned, an air tightness test shall be made on all ductwork. A minimum pressure equal to fan static pressure at less than 10% of design flow or 2 1/2 times design external static pressure, whichever is less shall be maintained during the test. A soap test shall be applied to all sheet metal connections and joints to locate air leaks. Air leaks which are in excess of that required to bubble the soap suds (that is, actually blow the suds away), shall be sealed by additional taping and caulking to reduce the leakage to a rate not to exceed slow bubbles forming. In lieu of the above tightness tests, the Contractor may test the ducts by attaching a fan with a capacity of not over 300 cfm at 2 1/2” static pressure to the ductwork and with outlets blocked air tight, build up the pressure in the ducts to 2” water gauge. If this pressure cannot be obtained the Contractor shall locate and repair the leaks as specified above. The Architect/Engineer and Owner's Representative shall witness the test and the Contractor shall notify the Insulation Contractor in writing when the test has been satisfactorily completed.

END OF SECTION 233000
SECTION 250000 - INTEGRATED AUTOMATION INDEX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish all service tools, equipment, etc., which are required for the complete installation of all Integrated Automation Work, as indicated on the Drawings and specified herein. Integrated Automation work indicated on the Drawings and/or specifications covering other trades shall conform to Division 25 of these Specifications.

B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Integrated Automation systems shall be accomplished without additional cost to the Owner.

C. Furnish all labor and materials required for Integrated Automation service connections to all the various items of equipment requiring controls service throughout the project shown on the Contract Drawings (even if not shown on Integrated Automation Drawings). Coordinate with other trades for the installation of required connections and service.

1.3 INTEGRATED AUTOMATION DIVISION INDEX

250500 GENERAL INTEGRATED AUTOMATION REQUIREMENTS
251100 ELECTRICAL CONTROLS AND INTERLOCKS
253000 CONTROLS AND INSTRUMENTATION

PART 2 – PRODUCTS

PART 3 - EXECUTION

END OF SECTION 250000
PART 1- GENERAL

1.1 SUMMARY

A. Section Includes: General Mechanical Requirements specifically applicable to Division 25 sections in addition to Division 1- General Requirements.

B. Scope:
   1. The work covered by this division consists of performing all operations in connection with the installation of heating, cooling, ventilating, and plumbing including site utility work as indicated under this section. This entire section applies to all mechanical work and all mechanical sections of these specifications. This Contractor shall read and comply with all sections of these specifications including all General and Special Conditions.

1.2 REFERENCES

A. Standard Requirements:
   1. For products or workmanship specified by association, trades, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. All work shall be executed in accordance with the local and state codes, ordinances, and regulations governing the particular class of work involved. This Contractor shall be responsible for the final execution of the work under this heading to suit these requirements. In the event of a conflict between the various codes and standards, the more stringent shall govern. Where these specifications and accompanying drawings conflict with these requirements, the Contractor shall report the matter to the Architect/Engineer. The Architect/Engineer shall prepare any supplementary drawings required, illustrating how the work may be installed so as to comply. On approval of the change by the Architect/Engineer, the Contractor shall install the work in a satisfactory manner without additional cost to the Owner. On completion of the various parts of the work, the installation shall be tested by the constituted authorities and approved, and on completion of the work, this Contractor shall obtain and deliver to the Owner final certificates of acceptance. This Contractor shall furnish copies of each certificate to the Architect/Engineer.

C. The Contractor shall secure all permits and licenses for his work and shall pay all fees in connection with such permits and licenses.

D. The contractor shall hold and save the Owner free and harmless from liability of any nature or kind arising from his failure to comply with codes and ordinances.

E. Any and all meter deposits and all utility extension costs shall be paid by the Contractor whose work is done in connection with the service that the meter is connected to.

F. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:
   1. AABC Associated Air Balance Council
   2. ADC Air Diffusion Council
      435 North Michigan Ave.
      Chicago, IL  60611
3. AMCA  Air Movement and Control Association  
30 West University Drive  
Arlington Heights, IL  60004

4. ANSI  American National Standards Institute  
1430 Broadway  
New York, NY  10018

5. ASHRAE  American Society of Heating Refrigerating and Air Conditioning Engineers  
345 East 47th Street  
New York, NY  10017

6. ASME  American Society of Mechanical Engineers  
345 East 45th Street  
New York, NY  10017

7. ASTM  American Society for Testing and Materials  
1916 Race Street  
Philadelphia, PA  19103

8. FM  Factory Mutual System  
1151 Boston-Providence Turnpike  
Norwood, MA  02062

9. FS  Federal Specification  
General Services Administration  
Specifications and Consumer Information Distribution  
Section (WFSIS)  
Washington Navy Yard, Building 197  
Washington, DC  20407

10. NBFU  National Board of Fire Underwriters  
5530 Wisconsin Avenue, Suite 750  
Chevy Chase, Maryland 20815

11. NEC  National Electric Code (of NFPA)

12. NEBB  National Environmental Balancing Bureau  
8224 Old Courthouse Road  
Vienna, VA  22180

13. NEMA  National Electrical Manufacturer's Association  
2101 L Street, NW
14. NSF  
National Sanitation Foundation  
Box 1468  
Ann Arbor, MI  48106

15. OSHA  
Occupational Safety and Health Administration  
U.S. Department of Labor

16. SMACNA  
Sheet Metal and Air Conditioning Contractor's National Association  
8224 Old Courthouse Road  
Vienna, VA  22180

17. TIMA  
Thermal Insulation Manufacturers Association  
Technical Services  
1420 King Street  
Alexandria, VA 22314

18. UL  
Underwriters Laboratories, Inc.  
333 Pfingston Road  
Northbrook, IL  60062

G. Underwriters Laboratories Inc. (UL): All materials, appliances, equipment, devices or appurtenances shall conform to the applicable standards of Underwriters Laboratories Inc., where such standards have been established.

1.3 DRAWINGS

A. Drawings and specifications shall be considered as cooperative, and work or materials called for by one and not mentioned in the other, or vice versa, shall be done and furnished as though treated by both.

B. In the cases of discrepancies in figures, drawings, or specifications, the Architect/Engineer shall be notified immediately and his decision shall determine the necessary adjustment. Without such decision, said discrepancies shall not be adjusted by the Contractor save only at his expense, and, in case of any settlement or any complication arising from such adjustment to the Contractor, he shall bear all extra expense involved.

C. Should it appear that the work intended to be done, or any of the matters relative thereto, are not sufficiently detailed or explained on the drawings or specifications, the Contractor shall apply to the Architect/Engineer for such further drawings or explanations as may be necessary, allowing a reasonable time for the Architect/Engineer to supply same, and the Contractor shall conform to same as part of the Contract.

D. Should any doubt or question arise in respect to the true meaning of the drawings or specifications, reference shall be made to the Architect/Engineer whose decision shall be final and conclusive. No alleged oral admission, condonation, or inadvertent neglect on the part of the Architect/Engineer will be accepted as an excuse for inferior work.
E. The mechanical plans do not give exact details as to elevations of ductwork and piping, exact locations, etc., and do not show all offsets, control lines, pilot lines, and other installation details. The Contractor shall carefully lay out his work at the site to conform to the structural conditions, provide proper grading of lines, to avoid all obstructions, to conform to details of installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated, satisfactory operational installation.

F. Should the particular equipment which any Bidder proposes to install, require other space conditions than those indicated on the drawings, the Bidder shall arrange for such space with the Architect/Engineer before submitting his bid. Should changes become necessary on account of failure to comply with these details, the Contractor shall make such necessary changes at his (the Contractor's own expense).

G. The Contractor shall submit working scale drawings of all his apparatus and equipment which in any way varies from these specifications and plans which shall be checked by the Architect/Engineer and approved before the work is started, Contractor before work proceeds. Interference with structural conditions shall be corrected by the Contractor.

H. All equipment shall be installed in accordance with the manufacturer's recommendations. Provide all accessories and components for optimum operation as recommended by the manufacturer.

1.4 SYSTEM DESCRIPTIONS
A. Not Used.

1.5 PRIOR APPROVALS
A. Each equipment item for which the Contractor desires to install equipment other than the specific item identified in the equipment schedule or equivalent equipment by manufacturers specifically named in the schedule, the Contractor shall bear full responsibility to prove to the Engineer that the furnished equipment is equivalent to or better than the specified item. Failure to provide such proof will result in rejection of the shop drawing submittal by the Engineer. Prior written or verbal approval by the Engineer of equipment by other manufacturers will not relieve the Contractor of responsibility to provide equivalence. Prior approval is not required, however, any prior approval given is intended only to provide preliminary agreement that the alternate manufacturer may make equipment that complies with the specification requirements and not that all equipment manufactured by him is acceptable.

1.6 SHOP DRAWINGS
A. Shop drawings or fully descriptive catalog data shall be submitted by the Contractor for all items of material and equipment furnished and installed under this Contract. This shall include piping, ductwork, mechanical equipment, plumbing equipment, control items, etc. The Contractor shall submit to the Architect/Engineer a sufficient number of copies of all such shop drawings or catalog data to provide him with as many review copies as he may need, plus three (3) copies for retention by the Architect/Engineer. No materials or equipment shall be installed until officially approved by the Architect/Engineer.

B. Before submitting Shop Drawings to the Architect/Engineer for review, the Contractor shall examine them and satisfy himself that they are correctly representative of the material or equipment to which they pertain. The Contractor shall so note these Drawings before submitting them. The Contractor's review of Shop Drawings is not intended to take the place in any way of the official review of the Architect/Engineer, and the Shop Drawings which have not been reviewed by the Architect/Engineer shall not be used in fabrication or installing any work.
C. The review of Shop Drawings or catalog data by the Architect/Engineer shall not relieve the Contractor from responsibility for deviations from the plans and Specifications unless he has, in writing, specifically called attention to such deviations as the time of submission and has obtained the permission of the Architect/Engineer thereon, nor shall it relieve him from the responsibility for error of any kind in Shop Drawings. When the Contractor does call such deviations to the attention of the Architect/Engineer, he shall state in his letter whether or not such deviations involve any extra cost. If this is not mentioned, it will be assumed that no extra costs are involved for making the change.

D. After receiving approval on the make and type of materials, the Contractor shall order such materials in sufficient time so that no delay or changes will be caused. This is done to facilitate progress on the job and failure on the part of the Contractor shall render him liable to stand the expense of any and all delays occasioned by failure on this part to provide necessary details. All shop drawings shall be delivered to the Architect/Engineer's office within thirty (30) days from the date of the contract.

E. Shop drawings will be returned unchecked unless the following information is included: reference to all pertinent data in the Specifications or on the drawings, size and characteristics of the equipment, name of the project and a space large enough to accept an approval stamp. The data submitted shall reflect the actual equipment performance under the specified conditions and shall not be a copy of the scheduled data on the drawings.

1.7 SUBMITTALS

A. Submittal data shall be organized in commercial quality, three ring binders with durable and cleanable covers. Product information for each piece of equipment shall be separated by an indexing leaf with clear tabs. The product name and symbol (i.e. AHU/Air Handling Unit) shall be typed on white paper inserts and placed in appropriate tab. Complete data must be furnished showing performance, quality and dimensions. A signed review by the Architect/Engineer must be obtained before purchasing any equipment.

B. The following items shall be submitted for review by the Architect/Engineer but are not limited to:
   1. Temperature Controls
   2. Vibration Equipment and Calculations

1.8 QUALITY ASSURANCE

A. General: Comply with Division 1.

B. Welder Qualifications: Welders shall be certified by the American Society of Mechanical Engineers (ASME) National Certified Pipe for the type of work being performed. Current operators' certificates in accordance with ASME standards shall be on file at the site and shall be available to the Architect/Engineer for examination. Coupons shall be available for review by the Architect and Engineer.

C. Locations of all pipes, ducts, outlets, appliance, etc., as shown on the drawings, are approximate only and are understood to be subject to such revisions as may prove necessary or desirable at the time the work is installed. Each Contractor will be required to install his work with relation to existing building conditions and shall be entirely responsible for the correctness of his work with reference to finished elevations, etc. Piping shown on the drawings is diagrammatic only and their exact locations, depths, and invert elevations shall be as required for proper flow and coordination with other trades.
D. The contract drawing depicts graphically the arrangement of piping and ductwork. Should local conditions necessitate a rearrangement, or if any of the piping or ductwork can be installed to better advantage in a different manner, the Contractor shall, before proceeding with the work, prepare and submit three (3) copies of Drawings of the proposed arrangement for the Architect/Engineer's review.

E. If the Contractor proposes to install equipment, including piping and ductwork, requiring space conditions other than those shown, or to rearrange the equipment, he shall assume full responsibility for the rearrangement of the space and shall have the Architect/Engineer review the change before proceeding with the work. The request for such change shall be accompanied by Shop Drawings of the space in question.

F. Each Contractor is responsible for the proper location and size of all slots, holes, or openings in the building structure pertaining to his work, and for the correct location of pipe sleeves.

G. Each Contractor shall coordinate his work with that of all other trades that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipe lines which require a stated grade for proper operation. Drainage lines shall take precedence over water lines in determination of elevations. In all cases, lines requiring a stated grade for their proper operation shall have precedence over electrical conduit and ductwork.

H. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Lubricate all equipment properly in accordance with manufacturer's instructions. Furnish zerk grease fittings on all greaseable bearings.

I. Equipment and Materials: The materials and equipment shall be new and shall be the standard products of the manufacturers regularly engaged in the production of Plumbing, Heating, Cooling, Ventilation, and Fire Protection Equipment, and shall be the manufacturer's latest standard design. Where two or more units of the same class of equipment are required, these units shall be the products of the same manufacturer. However, the component parts of the systems need not be the products of the same manufacturer. Specific equipment specified hereinafter is to be considered a standard of quality and operation. In general, all capacities of equipment, and motor and starter characteristics are shown in schedules on the drawings. Reference shall be made to the schedules for specific information. The capacities shown are minimum capacities. Variations in the characteristics will be permitted only on written approval of the Architect/Engineer. All equipment shall be shipped to the job with not less than a prime coat of paint or as specified hereinafter. Insofar as is possible all items of the same type (i.e., pumps, fans, etc.) shall be by the same manufacturer. Where installation instructions are not included in these specifications or on the plans, the manufacturer's instructions shall be followed. All equipment affected by altitude shall be rated to operate at the altitude where it is to be installed.

J. Excavation and Backfilling: This Contractor shall do all necessary excavation and backfill for the installation of the Mechanical systems as may be required. Curb cuts, asphalt and concrete patching, cutting and patching existing floor, etc., shall be part of this Contractor's responsibility. No extra payment will be made for rock excavation. Trenches for all underground piping shall be excavated to the required depths. The bottoms of trenches shall be tamped hard and graded to secure maximum fall. Bell holes shall be excavated to assure the pipe resting for its entire length on solid ground. Should rock be encountered, it shall be excavated to a depth of 6 inches below the bottom of the pipe, and before laying the pipe, the space between the bottom of the pipe and the rock surface shall be filled with gravel, thoroughly tamped. Pipe laid in trenches dug in fill shall be supported down in the trenches and shall be filled. No roots, rocks or foreign
materials of any description shall be used in backfilling the trenches. The backfill material shall be identical to the surrounding fill material and shall be placed in 6-inch layer, wetted, and compacted to the density of the adjacent soil. See Division 2 for additional information for site utilities. All surplus materials shall be hauled from the project by the Contractor at his expense.

K. Cutting and Repairing:
   1. Responsibility of the Contractor whose work is involved. Coordinate with others to prevent unnecessary cutting and repairing.
   2. Lay out and locate equipment, openings, and chases. Install sleeves, inserts, and supports. Arrange with those whose work is involved to do cutting and replacing caused by negligence or error with costs reimbursed by the Contractor at fault. Cutting and replacing of existing work shall be the responsibility of the Contractor whose work is being installed.
   3. Removal or terminating connections of existing work which is abandoned or replaced shall also be done hereunder to provide correct and finished work.

L. Foundations: All equipment shall be provided with suitable foundations and supports. It shall be the responsibility of the Contractor to provide for the proper locations of these foundations and supports. This applies to all rooftop equipment also.
   1. All concrete foundations required by equipment furnished by the Mechanical Contractor shall be constructed by them (except where otherwise noted) the conformity with the recommendations of the manufacturer of the respective equipment, and with the approval of the Architect/Engineer. All corners of the foundations shall be neatly chamfered. Foundation bolts shall be placed in the forms when the concrete is poured. Allow 1 inch below the equipment base for alignment, leveling and grouting with nonshrinking grout. Grouting shall be done after the equipment is leveled in place. After the grout has hardened, the foundation bolts shall be pulled up tight and the equipment shimmed, if necessary. After removal of the forms, the surface of the foundation shall be rubbed.
   2. Unless otherwise noted, foundations shall be a minimum of 6-inch high. All concrete work performed by these Contractors shall conform entirely to the requirements of the Concrete Specifications which describe this class of work.

M. Code Requirements: Comply with state and local code requirements and ordinances. Call for inspections required by responsible building inspection authority.

N. Applicable Building Codes and Ordinances: Including the latest edition of each code, but not limited to the following:
   2. Uniform Mechanical Code.
   4. Governing Fire Department Requirements
   5. Utility Company Requirements
   6. National Fire Protection Association Standards
   7. NFPA 70 - National Electrical Code
   8. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
9. NEPA 90B - Installation of Warm Air Heating and Air Conditioning Systems
10. NFPA 13 - Sprinkler Systems
11. NFPA 101 - Life Safety
12. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment

O. ACCESS PANELS
1. Similar to Milcor, or as noted on the drawings, size as required for concealed expansion joints, valving, gauges, balancing dampers, valves, traps, pitot stations, equipment and similar items requiring accessibility. Notify the General Contractor of each access panel location and the required size. Panels shall be proper type for ceiling or wall in which they are installed. The panels shall be furnished under this section of the Specifications, unless otherwise directed, but shall be coordinated to be compatible with walls and ceilings furnished under other sections.

1.9 DELIVERY, STORAGE AND HANDLING
A. General: Comply with Division 1.
B. Large Items: Make arrangements with other trades on the job for introduction into the building of equipment too large to pass through finished openings.
C. Acceptance: Check and sign for materials to be furnished by others for installation under all Mechanical Divisions upon delivery. Contractor shall be responsible for the storage and safekeeping of such materials from time of delivery until final acceptance.
D. Protection: Close ends of pipe and ductwork at the close of each working day during construction to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Protect fixtures and equipment against damage during mechanical work with heavy paper or plastic until final clean-up.
E. Storage: Store equipment in covered enclosure or wrap with weather tight 6 mil Visqueen.
F. Shipping Protection: Protective casings, crating, and coverings to remain in place until start-up of equipment.

1.10 PROJECT CONDITIONS
A. Performance: All systems are to be rated at 4,500 ft. elevation.

1.11 SEQUENCING AND SCHEDULING
A. General: Comply with Division 1.
B. Schedule: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.
C. Utility Interruptions: Schedule mechanical utility interruptions with the Architect/Engineer/Owner minimum of seven (7) days prior to the requested outage. Plan work so that duration of the interruptions a maximum of one day.

1.12 CONTROLS WIRING AND ELECTRICAL EQUIPMENT
A. All mechanical equipment controls wiring, conduit, relays, interlocks, and all accessories required for a completely operational controls system shall be the complete responsibility of the
mechanical contractor. The mechanical contractor has the option to hire the project electrical contractor or any qualified controls contractor to install mechanical controls wiring and conduit. Refer to Specification Section 253000 for coordination requirements between mechanical, electrical, and controls subcontractors.

B. Electrical items such as disconnect switches and motor starters associated with equipment provided by Division 25, when specifically mentioned to be furnished by the Mechanical Contractor, whether in these specifications or on the Electrical or Mechanical Drawings, shall be furnished by the Contractor. These items shall be mounted and connected as required for a completely operational system. See Control Systems Specification for further information.

C. All electrical equipment characteristics (voltage, etc.) must be verified by the Contractor prior to ordering. If the Contractor proposes to furnish motors varying in horsepower and/or characteristics from those specified, he shall first inform the Architect/Engineer of the change and shall then coordinate the change with the Electrical Contractor and shall pay all additional charges in connection with the change.

1.13 PROTECTION AGAINST HAZARDOUS CONDITIONS

A. The Contractor shall take precautions against hazardous construction conditions at all times during construction. The final condition of the facilities shall be safe, and where safety to operating personnel is jeopardized, suitable signage shall be posted.

B. Protruding metal (bolts, steel angles, etc.) potentially hazardous to maintenance and operating personnel, shall be cut back and/or protected to reduce the risk of injury. All openings between floors shall be protected with barriers around the openings, gratings across the openings, or steel bars through the openings to avoid and protect against injury.

1.14 HAZARDOUS SIGNS

A. Equipment room contains moving or rotating parts, floor openings, or other potentially hazardous environments and shall include a sign on the door entering it that shall read similar to the following: Hazardous Area - Authorized Personnel Only.

1.15 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Mechanical Contractor shall furnish to the Owner a bound manual in triplicate, containing complete repair parts lists, and operating, service, and maintenance instructions on all mechanical equipment, fixtures, and systems.

B. The Mechanical Contractor shall also provide training as required by Section 230100 to the Owner’s operation and maintenance personnel.

1.16 OPERATION PRIOR TO ACCEPTANCE

A. The Owner shall have the right to operate any and all apparatus as soon as and as long as it is in operating condition, after Owner personnel have received operational training, whether or not such apparatus has been accepted as complete and satisfactory, except that this shall not be construed to mean operations before any required alterations or repairs have been made. This operation does not indicate acceptance of the equipment by the Owner. When the Contractor enters into a contract with the Owner, he agrees to the above.

1.17 WARRANTY AND SERVICE PROGRAM

A. Due to the critical performance requirements and to clearly establish warranty responsibility for this project, the Contractor shall provide a full service maintenance and warranty program to the Owner for one full year after beneficial occupancy (substantial completion).
B. This service program shall be included as part of the base bid and shall include service, maintenance, repair, replacement, lubrication, temperature control calibration and repairs, and documenting proof for all service and maintenance work on all equipment and system furnished by the Contractor.

C. A single representative in the employment of the Contractor shall be responsible for coordination and follow through of this program. This representative's name and phone number shall be submitted to the Owner as part of the maintenance manuals and supportive data. The Contractor shall respond to a request for service with 24 hours if so requested.

D. During this first year of operation, the following sequence of maintenance service shall be performed as a minimum.

   1. Clean strainers in piping.
   2. Fans and/or pumps be lubricated and oiled once every four (4) months.
   3. Controls shall be calibrated throughout the facility at the end of six (6) months (following substantial completion). Any leaks in the piping systems shall be repaired.
   4. All equipment manufacturers’ service recommendations shall be followed during this period.

1.18 FLUSHING AND DRAINING

A. It shall be the responsibility of this Contractor to properly drain and flush all ducts and pipes before use or acceptance to ensure that all debris is completely removed. Damage caused by such debris remaining in the ducts or pipes shall be repaired by this Contractor at his expense. This Contractor shall demonstrate to the Architect/Engineer's representative that all piping is clean.

1.19 CLEANING

A. This Contractor shall remove from the building construction site all rubbish and dirt as it accumulates under the contract. At completion, all areas shall be broom cleaned and all obstructions, surplus materials, etc., removed.

1.20 GUARANTEE

A. The Contractor shall guarantee all materials, equipment, and workmanship furnished and installed by him under this Contract, to be free from all defects of workmanship and materials, and shall agree to replace at his expense, without expense to the Owner, at any time within one year after installation is accepted by the Architect/Engineer, any and all defective equipment, parts, etc., that may be found. (This excludes normal maintenance and daily servicing of equipment which is the Owner's responsibility.)

1.21 FLOOR, WALL, AND CEILING PLATES

A. Where exposed pipes pass through floors, finished walls, or finished ceiling, they shall be fitted with chromium-plated escutcheons of an approved pattern. Escutcheons and plates in Mechanical Rooms do not require chrome finish.

B. This Contractor shall be responsible for providing and installing all counter flashing. All openings in the roof shall be flashed and counterflashed. Use four pound lead flashing materials for all vent lines and welded flashing in steel lines passing through roof. The Mechanical Contractor shall notify the General Contractor where each roof penetrations is and the size of the opening.
1.22 PIPE SLEEVES

A. Schedule 40 steel pipe sleeves or pipe sleeves made of No. 20 gauge galvanized steel, properly secured in place with approximately 1/4" space between each sleeve and the surface of the pipe and/or insulation passing through it, shall be provided for all pipes passing through concrete floors, roofs, and masonry walls. All pipe sleeves shall be fixed in place as the walls and floors are built up. The Contractor shall furnish and locate all sleeves and pipes passing through concrete floors, exterior masonry walls, and roofs shall be made watertight with approved non-hardening plastic material. Sleeves through pipe chase or equipment room floors shall project a minimum of 2-inch above the floor and shall be of black steel pipe with waterproof flange at center of floor thickness. Each sleeve through a fireproof wall shall be packed with approved fireproof rope in the annular space.

1.23 PIPE HANGERS

A. Pipe hangers shall be Fee and Mason of a type suitable for each use. Perforated straps shall not be used in any work. For ferrous pipes up to and including 4 inch in size, use Fee and Mason Fig. 199 malleable iron, adjustable, split ring, swivel hanger. For plumbing piping larger than 4 inch, use Fee and Mason Fig 239 steel clevis hanger. Where several pipes are parallel at the same elevation, trapeze hangers may be used. Where trapeze hangers are used, the pipes shall be supported on rollers where indicated on the Drawings. For copper pipes up to and including 3 inch in size, use Fee and Mason Fig. 360 malleable iron, copper plated hangers. For copper pipes larger than 3 inch, use Fee and Mason Fig. 364 copper plated clevis hanger.

B. Hanger rod sizes shall conform to the following schedule:

1. Pipe up to and including 2" 3/8" rods
2. Pipe 2-1/2", 3" and 3-1/2" 1/2" rods
3. Pipe 4" and 5" 5/8" rods
4. Pipe 6" 3/4" rods
5. Pipe 8", 10", and 12" 7/8" rods

C. Unless shown otherwise on the Plans, all horizontal runs of ferrous piping shall be suspended from the floor or roof construction, as the case may be, by means of hangers with the following spacing:

1. Pipe up to and including 1-1/4" 8'
2. Pipe 1-1/2" and 2" 10'
3. Pipe 2-1/2" and 3" 12'
4. Pipe 3 1/2" and 4" 14'
5. Pipe 5" and 6" 16'
6. Pipe 8" and 10" 20'

D. Unless shown otherwise on the Plans, all horizontal runs of copper piping shall be suspended from the floor or roof construction as the case may be, by means of hangers with the following maximum spacing:

1. Pipe up to 3/4" in size 5'
2. Pipe 1" and 1-1/4" 6'
3. **Pipe 1-1/2" and larger**
   10’

E. There shall be a hanger within 2 inch of each elbow or tee. Additional supports shall be provided for valves, strainers, etc. Cast iron pipe shall have not less than one hanger per length of pipe. Vertical risers shall be supported by approved riser clamps at each floor. Vertical pipes within a space shall have not less than two supports.

F. Supports and hangers shall be installed to permit free expansion and contraction in the piping systems. Hangers shall permit vertical adjustment to maintain proper pitch. Where necessary to control expansion and contraction, the piping shall be guided and firmly anchored. No piping shall be self-supporting, nor shall it be supported from equipment connection.

G. Expansion bolts shall be Ackerman-Johnson or Hilti.

H. Beam clamps suitable for use with this type of steel construction involved shall be Grinnell.

1.24 **PRESSURE VESSEL CERTIFICATION**

A. Not used.

1.25 **ISOLATION**

A. Excessive vibration or objectionable noise created in any part of the building by the operation of any equipment furnished and/or installed under the Mechanical Contract will be extremely objectionable and the Contractor shall take all precautions against the same by isolating the various items of equipment from the building structure and by such other means as may be necessary to eliminate all excessive vibration and objectionable noise produced by any equipment installed by them, and consequently, they shall design all foundations, supports, etc., for their equipment, and all piping with this end in view. In addition, these Contractors shall supervise the construction of all foundations and supports, whether they build them or not, in order that they may be constructed in such a manner as to prevent the transmission of objectionable noise and/or excessive vibration. Submit calculations on all vibration isolation equipment.

B. All equipment having moving parts shall be isolated from the building structure by means of Korfund isolation materials, unless specifically noted otherwise. All isolators shall be the same brand and shall be supplied from the same source. Equipment manufacturer's recommendations shall be followed in the isolation of equipment.

C. Vibration isolators shall have sufficient resilience to meet the following minimum efficiencies:

<table>
<thead>
<tr>
<th>Motor HP</th>
<th>Equipment Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5</td>
<td>90%</td>
</tr>
<tr>
<td>7-1/2 to 15</td>
<td>93%</td>
</tr>
<tr>
<td>20 to 40</td>
<td>95%</td>
</tr>
<tr>
<td>50 to 100</td>
<td>97.5%</td>
</tr>
</tbody>
</table>

D. Spring isolators shall be of the housed type with ribbed pads bonded to the underside of the baseplate, or may be unhoused stable springs. Isolators shall be furnished with snubbers and limit stops where so recommended by the equipment manufacturer.

E. The Supplier of the isolating equipment shall, upon completion of the job, check all isolating materials and verify that they are installed properly, and submit a report in writing to the Architect/Engineer.
1.26 TESTING
A. Before completion of this project, the Mechanical Contractor shall test all materials and equipment which normally require testing. All piping, etc., shall be tested to meet code requirements or the Specification requirements, whichever is more stringent.
B. All equipment shall be operated sufficiently long enough to prove to the Architect/Engineer that the equipment performs satisfactorily and meets the requirements set forth on the Plans or in these Specifications.

1.27 CERTIFICATIONS
A. Before receiving final payment, the contractor shall verify that all equipment furnished and all work done is in compliance with all applicable codes mentioned in these Specifications. Submit certifications and acceptable certificates to the Architect/Engineer.

1.28 GENERAL PIPING INSTALLATION REQUIREMENTS
A. Provisions for Drainage: All piping systems shall be installed so that they may be easily drained. Drain caps, plugs, or hose bibbs shall be installed at low points. Grade piping toward drain locations.
B. Alignment: All installed pipe lines shall be straight and shall remain straight against strains. Proper allowance shall be made for expansion and contraction.
C. Clean as Installed: All piping shall be kept free from scale or loose dirt when installed, and must be kept clean during the completion of the installation. All openings in the piping system shall be capped or plugged while awaiting further connections. All detergents, solvents and other cleaning agents shall be compatible with the materials of fabrication of the system in which they are used. They shall not adversely affect the materials of mechanisms in the systems and they shall be acceptable to equipment manufacturers. All detergents, solvents, and other cleaning agents shall also be compatible with the process streams to be handled by the systems in which they are used.
D. Insulated Fittings: Install between any dissimilar metals such as steel and copper.
E. Expansion and Contraction: The Contractor shall make all necessary provisions for expansion and contraction with proper fittings, anchors, dresser couplings, loops, etc. Install flexible connectors on each pipe at each building expansion joint.
F. Welding: Refer to Paragraph 1.29 of this section of these specifications.
G. Bending: No bending of pipe will be permitted.
H. General: The installation shall be coordinated with respect to space available with heating, cooling, ventilating, and electrical installation. In every instance where there is a conflict in the routing of the piping and the ducting, the routing of the ducting shall govern. Installed piping shall not interfere with the operation or accessibility of doors or windows, shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Cutting or weakening of structural members to facilitate piping, installation is not permitted. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping above ground shall be run parallel with the lines of the building unless otherwise noted on the drawings. Unless otherwise shown on the drawings, horizontal piping shall pitch down in the direction of flow
with grade of not less than 1 inch in 40 feet. Piping connections to equipment shall be in accordance with details shown on the drawings or as recommended by the equipment manufacturer. Service pipe valves and fittings shall be kept a sufficient distance from other work to permit finished covering not less than 1/2 inch from such other work, and not less than 1/2 inch between finished covering on the different services.

I. Installation of Valves: Valves shall be installed at the locations shown on the drawings and where specified and where directed at site. Gate valves shall be used unless otherwise shown, specified, or directed. All valves shall be installed with their stems horizontal or above. Where tight shutoff is required, a composition seat globe valve or resilient seat ball valve shall be used.

J. All valves which must be used during operation, all control valve assemblies, instrument control cases, liquid level controls, gage glasses, orifices, relief valves, and other equipment which must be observed, adjusted, or serviced during operation shall be located conveniently accessible from an operating platform or grade.

K. In general, relief valves within processing unit limits shall be located conveniently accessible from an operating platform or grade.
   1. Those in non-hazardous service, such as water, shall discharge directly to outside.
   2. Relief valves should have no piping between the vessel or line and the valve inlet, except as shown on the drawings.
   3. Relief valves shall be installed in a vertical position. Vent piping shall be braced and supported in a manner that will not produce excessive stresses in the relief valve and will permit removal of the relief valve without necessary temporary supports for the vent lines.

L. Equipment Connections: All piping connections to pumps and other equipment shall be installed without strain at the pipe connection of the equipment. The contractor shall be required as directed to remove the bolts in flanged connections or disconnect piping to demonstrate that the piping has been so connected. Pipe connections to equipment shall be made with unions or flanged fittings. Provide removable headers for large equipment for service access.

M. Joints
   1. Flanged Joints: All flanged joints shall be face matched. Raised face flanges shall not be mated to flat-faced cast-iron flanges on valves or equipment. The raised face must be turned off. All flanged bolt holes shall straddle the horizontal and vertical center line unless otherwise noted.
   2. Screwed Joints: Screwed pipe joints shall have American Standard Taper Pipe Threads ANSI-B2.1 Latest Edition. Burrs formed when cutting pipe shall be removed by reaming. Care shall be taken that the inside of pipe is thoroughly clean and free of cutting oil and foreign matter before installation. Joints shall be made perfectly tight by the use of Teflon tape or approved Teflon thread sealing and lubricating compound.
   3. Solder-Joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool or wire brush before seating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections. Joints for serrated fittings on water, compressed air below 60 psig, and vacuum lines shall be made with a 95 percent tin and 5 percent antimony. Cored solder or solder containing lead will not be permitted.
N. Reducers: Reduction in pipe size shall be made with one piece reducing fittings. Bushings reducing at least two pipe sizes will be acceptable only when there is no room for reducing couplings or swaged nipples.

O. Unions: All piping unions shall be of the ground joint type constructed from materials equivalent in alloy composition and strength to other fittings specified with which they are used. Union Pressure classes and end connections shall be the same as the fittings used in the lines with the unions. Steel unions shall have hardened stainless steel seating surfaces on both faces.

1.29 WELDING

A. All welding of piping covered by this specification, regardless of condition of service shall be accompanied as follows:

1. The welding shall be in accordance with the recommendations of the American Welding Society. Mitering of pipe to form elbows, notching to form these, or any similar construction will not be permitted. Welding fittings shall be installed on all welded lines. Joints to be welded shall be properly aligned and spaced, using special welding clamps where necessary. All welders to be employed shall have passed qualification tests prescribed by the National Certified Pipe Welding bureau (or by another reputable testing laboratory or agency) using procedures approved by the American Society of Mechanical Engineers or the American Welding Society. The welders will be required to pass qualification tests when the work of the welder creates a reasonable doubt as to his proficiency. Tests shall be conducted at no additional expense to the Owner.

2. Each welder shall, in addition to having passed the prescribed qualification tests (as noted in Paragraph 1.30.A.1), prepare sample coupons at the job site on a portion of pipe that is cut such that the cross section of the weld is open to view. The sample weld should be prepared using a 6 inch diameter pipe. The sample shall reflect a continuous weld with perpendicular cut out to show the weld in cross sectional view. This sample, when accepted and approved by a certified welding inspector, shall be used as a standard of quality to compare to other welds that this welder will be performing on the job. This same sample weld will also be a basis for accepting or rejecting the welder for working on this project. The sample weld shall be identified with a date and the welder's name and shall be kept at the site throughout the project.

3. All welding on pressure piping shall conform to all of the requirements of the American Society of Mechanical Engineers Code for Pressure Piping - B31.1 (An American National Standards Institute publication), as defined in the latest edition of the ANSI Power Piping B31.1 Manual. All welding shall also conform to all of the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. All chapters, current addenda and supplements of these manuals shall apply. This code shall be used to establish standards of performance and quality of welds. However, the Owner reserves the right to perform radiographic testing of all welds, to compare any of the welds to the approved "standard" sample welds of each welder, and to compare the welds to the welding diagrams and sketches of those recommended in the ANSI B31.1 Power Piping Manual. The intent is to obtain the highest quality welding job possible. The cost of any initial radiographic testing, for random inspection, shall be paid for by the Owner. If radiographic random testing reveals that a weld is defective, the Contractor shall bear the cost of all repairs and re-testing necessary to be made to subject weld until conformance with radiographic tests is reached. The potential for random radiographic testing and welding quality control applies to all pressure piping systems in this project, including systems below 100 psig. If a question should arise regarding the possibility of faulty
welding or if there are obvious visual defects in the welding, the Contractor shall be required to correct such deficiencies to a quality level consistent with the recommendations, welding diagrams and sketches in the ANSI B31.1 Manual. The quality level shall also reflect that of the approved sample welds accomplished by each welder for this particular project.

1.30 COOPERATION WITH OTHER TRADES
A. The Contractor shall refer to other sections of these specifications covering the work of other trades which must be carried out in conjunction with the mechanical work so that the construction operations can proceed without harm to the Owner from interference, delay or absence of coordination.

1.31 FIELD MEASUREMENTS
A. The Contractor shall verify the dimensions covering the mechanical work at the building. No extra compensation shall be claimed or allowed on account of difference between actual dimensions and those indicated on the drawings. He shall examine the adjoining work on which Mechanical work is dependent for maximum efficiency, and shall report any work which must be corrected. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable work conditions affecting Mechanical work.

1.32 SAFETY GUARDS
A. The Mechanical Contractor shall furnish and install safety guards required in order to obtain certificates of inspection from all authorities having jurisdiction. All belt driven equipment, projecting shafts, and other rotating parts shall be enclosed or adequately guarded. Provide coupling guards on all rotating shafts.

1.33 PROTECTION
A. All work, equipment, and materials shall be protected at all times to prevent obstruction, damage, or breakage. All pipe openings shall be closed with caps or plugs during installation. All equipment shall be covered and protected against dirt, water, chemical, or mechanical injury. At the completion of the work, all equipment shall be thoroughly cleaned and the entire system shall be delivered in a perfect, unblemished condition.

1.34 PAINTING AND IDENTIFICATION
A. All equipment shall be delivered to the job with suitable factory finish. Should the finish be marred in transit or during installation, it shall be finished to present a neat, workmanlike appearance.
B. Except as elsewhere hereinafter specifically required, any painting of equipment, piping, ductwork, grilles, insulation, etc., furnished and installed under this Section of the Specifications will be done by the Painting Contractor. However, the Mechanical Contractor shall leave his equipment clean and free from any grease, dirt, rust, etc., and in suitable condition for painting.
C. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent them being rendered illegible during the painting operation.
D. The piping shall be painted the basic color as indicated in other sections of these specifications and shall be marked every 10 feet on centers with Brady pipe markers. Arrows, approximately 6 inch in length and spaced about 10 feet on centers shall indicate the direction of the flow pipe. Locate additional labels as required in Mechanical Rooms. Staple in place, brush with clear paint.
lacquer. Markers shall state pipe size, flow direction, and pipe usage (such as "cold water," etc.).

1.35 RECORD DRAWINGS

A. The Contractor shall, during the execution of the work, maintain a complete set of drawings upon which all dimensional locations of equipment piping and all deviations and/or changes in the work shall be recorded. Water, storm, and drainage mains shall be delivered to the Architect/Engineer in good condition upon the completion and acceptance of the work and before final payment is made.

1.36 SUPPLIER RESPONSIBILITY

A. Each supplier, whether furnishing equipment as specified or as a substitution shall be responsible for certifying that the equipment is properly installed and that the warranty is valid. Submit written reports on the installation and the equipment performance when requested to do so by the Architect/Engineer (or his representative). Each supplier shall be responsible for furnishing qualified personnel at the job site at anytime requested by the Architect/Engineer (or his representative) during the construction or warranty periods.

END OF SECTION 250500
SECTION 251100 - ELECTRICAL CONTROLS AND INTERLOCKS

PART 1 - GENERAL

1.1 Conform with applicable provisions of the General Conditions, Supplementary Conditions and General Requirements.

1.2 RELATED WORK IN OTHER SECTIONS

260519 - CONDUCTORS
260526 - GROUNDING
260533 - RACEWAYS, BOXES AND FITTINGS
262726 - WIRING DEVICES AND PLATES

1.3 DESCRIPTION OF WORK

A. All disconnect means, motor controllers, electrical controls, protective, and signal devices for equipment furnished under Division 25 of these specifications will be installed and connected as scheduled herein or as otherwise noted on the drawings.

B. Electrical items not shown on the electrical drawings, but which are required for equipment furnished under Division 25 of this specification shall be furnished under this section of the specifications and shall be installed and electrically connected in conformance with Division 26 Specifications.

1.4 SUBMITTALS

A. Submittal data for each individual electrically controlled item of equipment or device furnished under this Division of these specifications shall include complete electrical wiring diagrams, and elementary control diagrams (ladder form) showing all internal and external wiring connections and services. The submittal data shall itemize all electrical characteristics that are of a special nature or critical to the electrical installation or control system. Such equipment and devices will not be considered for approval until these requirements are met. These submittals shall form a part Section 250500 requirements and shall be properly coordinated by the Contractor.

B. As soon as possible after contract notice to proceed, one print of the ladder diagrams shall be submitted by the contractor showing all necessary wiring for the mechanical equipment and devices proposed for installation. This print shall be reviewed and approved by the contractor, and then submitted to the Architect/Engineer for approval. The print shall indicate all components which shall be wired to the control/power circuits by the contractor, with all terminals for external connections of the components identified and labeled to correspond to the manufacturer's designations. Internal or factory installed wiring of package-type components need not be shown. Control diagrams shall show all internal and external wiring connection and shall clearly indicate field wiring furnished and installed under Division 25, differentiated from field wiring furnished and installed under Division 26.

C. Revised Drawings: After the Architect/Engineer has approved the marked copy of the control diagrams submitted in accordance with Paragraph B above, the Contractor shall issue prints to all involved parties. The control diagrams shall be certified in writing as being acceptable to
the contractor. The approved drawings will then be included in the control submittal and the Operating and Maintenance Manual.

1.5 INSTALLATION
   A. No control work shall be performed until control submittal has been approved by the Architect/Engineer.

1.6 CHANGES DURING CONSTRUCTION
   A. The complete responsibility and costs for revisions during construction to the approved control diagrams, and the resultant changes to the installation requirements, not covered by contract change order, shall be assigned to the contractor requesting such revisions.

PART 2 - PRODUCTS

2.2 CONTROL AND INTERPOSING RELAYS
   A. Relays other than those on I/O cards shall be general purpose, enclosed plug-in type with 8 pin octal plug and protected by a heat and shock resistant dust cover. Relays shall be of the Neon or LED indicator type.

   B. Relay contact configuration and ratings shall be for rated load voltage and exceed load current rating by no less than fifty percent. Minimum contact rating shall be 10 amps at 120 volts AC.

2.3 TERMINAL STRIPS
   A. Terminal strips shall be of the molded nylon or polypropylene barrier type, individual plug-in mounted on a mounting channel. Terminal connections shall be rated 300 volt, 40 amp and shall be of the tubular clamp type for use with bare wire ends, or of the strap screw type for use with crimp spade lug prepared wire ends. Terminal strips shall provide for removable marking strips or have pre-painted matte finish marking surfaces. Buchanan 600 series or approved substitute.

PART 3 - EXECUTION

3.1 RELAYS
   A. All remote field devices shall be controlled through the use of an interposing relay. In no case shall a contactor or motor starter be directly controlled from a solid state device output or relay contact of a rating less than that stated above.

3.2 COMPONENT IDENTIFICATION
   A. All individual components (relays, timers, terminal strips, etc.) shall be clearly marked with the identification nomenclature shown on the manufacturer's shop drawings. Identification shall be by the use of press-type tape strip (kroy) covered with Scotch 600 clear tape or approved substitute method.

3.3 CONTROL WIRING INSTALLATION
   A. The installation and wiring of all electrical equipment installed under this contract shall meet all Electrical Division specifications. Special attention is called to the following:
1. All wiring to be in conduit.

2. All control wiring to be color-coded throughout. Conductor color shall be consistent for the entire length of circuit.

3. All splices shall be made in junction boxes on terminal strips.

4. All control wiring to terminate on marked terminal strips and shall be marked at all terminal points. Both ends of each wire shall be marked with a designation shown on the manufacturer's shop drawings, using interlocking chevron shaped snap-on plastic markers, hot-marked shrinkable tubing, hot stamping of the wire, or clear shrink-on tubing securing adhesive labels. Markers which depend solely on adhesive are not acceptable.

END OF SECTION 251100
SECTION 25 30 00 - CONTROLS AND INSTRUMENTATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS
   A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
   A. Furnish and install a control system, complete in all respects to provide the Sequence of Control shown on the drawings.
   B. All disconnect means, motor controllers, and all protective and signal devices for all electrical equipment provided under all Electrical Divisions will be furnished, installed and connected under all Electrical Divisions with the following exceptions:
      1. All controls wiring and conduit for HVAC equipment is the complete responsibility of all Mechanical Divisions. Electrical connections, relays, interlocks, etc. not shown on the electrical drawings, but which are required for equipment furnished under all Mechanical Divisions shall be installed and electrically connected by all Mechanical Divisions in conformance with all Electrical Division Specifications.
      2. All disconnect means, motor controllers, and all protective and signal devices furnished with, mounted on and connected integral with equipment furnished under other divisions.
      3. All disconnect means, motor controllers, electrical controls, protective, and signal devices for equipment furnished under all Mechanical Divisions of these specifications will be installed and connected as scheduled herein or as otherwise noted on the drawings.
   C. The mechanical trade is entirely responsible for furnishing, installing, wiring, connecting and placing the control systems in operation. Electrical work required will be the final responsibility of the Mechanical Contractor either by his own electricians or by his subcontract with an Electrical Contractor.

1.3 RELATED WORK IN OTHER SECTIONS
   230593 - BALANCING OF MECHANICAL SYSTEMS
   250000 - INTEGRATED AUTOMATION INDEX
   250500 - GENERAL INTEGRATED AUTOMATION REQUIREMENTS

1.4 GENERAL REQUIREMENTS
   A. The control system shall be furnished complete for the heating and air conditioning systems by Alteron, Invensys (Siebe), Delta, TAC (Andover), and Honeywell. The temperature control company shall have a permanent, fully staffed, well-established, local office and service organization. A complete stock of all repair and replacement parts for all items furnished under this contract shall be carried in stock at the local office at all times.
   B. Submittals: Shall include plan size drawings, with individual literature on each item, showing control sequences, complete electrical ladder diagrams and all control components and their...
wiring requirements. The Contractor shall be responsible to see that all systems are properly coordinated.

C. Operation and Maintenance Manuals: As soon as possible after Award of Contract, the Contractor shall prepare an Operation and Maintenance (O & M) Manual and submit it to the Engineer for review and approval. The control system testing and training specified hereafter shall not be conducted until the O & M Manual has been approved. See Specification Section 251000 – Direct Digital Control Software and Components. The Manual shall contain, as a minimum:

1. Approved control diagrams.

2. Equipment and device catalog cuts identifying each control device with a unique number or symbol coordinated with the control diagram symbols.

3. A Sequence of Control for each system's control diagram identifying the function and physical location of each adjustable control device, written in language understandable to personnel not specifically trained in HVAC control systems.

4. A Troubleshooting section for each control system indicating what tests and/or adjustments can be made to identify and/or correct common problems with control systems of the type installed. This description should address procedures to determine the cause of high or low space temperature and/or humidity in a typical room served by each air handling system. The description should be adequate to lead untrained persons to conclude, at minimum, whether the unit is receiving adequate primary cooling or heating, whether mixed air and supply air temperatures are reasonable and whether field adjustments or technical service is required to solve the problem. This troubleshooting section shall be bound in a separate section of O & M Manual and shall clearly refer to control device symbols shown on the Control Diagram drawings.

1.5 SPECIAL REQUIREMENTS

A. The controls trade shall check and adjust his control system completely, four (4) times during the warranty period. The fourth (4) check to be made during the final thirty days of the warranty period.

B. The controls trade will furnish the Owner with an accurate, up-to-date wiring diagram of all electrical and electronic equipment installed under this contract.

C. The Contractor shall furnish a complete set of parts lists, operating instructions and maintenance literature, in duplicate, for proper maintenance of all control equipment.

D. Steel lockable covers shall be provided for all space thermostats where shown on the drawings and where the space thermostat could be damaged.

PART 2 - PRODUCTS

2.1 CONTROL AND INTERPOSING RELAYS

A. Relays other than those on I/O cards shall be general purpose, enclosed plug-in type with 8 pin octal plug and protected by a heat and shock resistant dust cover. Relays shall be of the Neon or LED indicator type.

B. Relay contact configuration and ratings shall be for rated load voltage and exceed load current rating by no less than fifty percent. Minimum contact rating shall be 10 amps at 120 volts AC.
2.2 TERMINAL STRIPS
   A. Terminal strips shall be individual plug-in type on a mounting channel. Terminal connections shall be rated 300 volt, 40 amp and shall be of the tubular clamp type for use with bare wire ends, or of the strap screw type for use with crimp spade lug prepared wire ends. Buchanan 600 series or approved substitute.

2.3 AUTOMATIC DAMPERS
   A. All automatic dampers shall be furnished by the controls trade and shall be constructed of galvanized sheet steel with bushings made of oil impregnated sintered bronze to give constant lubrication. Each damper section shall have positive closing neoprene blade and edge seals. Outside air, return air and relief dampers shall have blades designed so that the blades are interconnected to give parallel movement. Each modulating damper shall provide a near linear relationship between damper opening and airflow. All volume dampers shall have opposed blades, which will produce equal pressure drop flow characteristics. Blade width shall not exceed 6 inches.

2.4 AUTOMATIC CONTROL VALVES - ELECTRIC
   A. The controls trade shall provide all automatic control valves and shall be made by the control manufacturer. All electric control valves 2" and smaller in size shall be brass body and trim, 2-1/2" and larger shall be iron body with brass or stainless steel trim. Valves shall be provided with renewable type seats and adjustable springs. Valves shall be designed to pass the quantity of water and with a maximum pressure loss not to exceed 10 ft. Valves shall be provided with "V" port or throttling type seat. Valves 2" or smaller shall be screwed. Valves 2-1/2" and larger shall be flanged. All sequencing valves shall have positive positioners.

2.5 DAMPER MOTORS - ELECTRIC
   A. The damper motor shall be electro-hydraulic type capable of providing full proportional control of dampers. The actuator shall be compatible with any low voltage controller or auxiliary device. One motor shall be provided per damper section.

2.6 CONTROL PANELS
   A. An enclosed control panel or panels with hinged door and locking device shall be installed where shown on the drawings. Panel layout shall be as shown. Thermometers switches and pilot lights will be flush mounted on the hinged door. Hard tubing shall be brought into the panel. Tubing within the panel may be plastic neatly bundled and tagged. All indicators and controllers will have descriptive bakelite tags.

2.7 FILTER GAUGES
   A. Shall be furnished and installed in each filter bank located in the Mechanical Room and at each rooftop air handling unit. Gauges shall be Dwyer Magnahelic with static pressure tips and interconnecting tubing. Range shall be approximately 1-1/2 times the nominal filter change out pressure differential. Each rooftop filter bank shall also have a differential pressure switch with indicator lamp located on a control panel in the Mechanical Room to indicate filter replacement pressure differential has been exceeded.

2.8 SMOKE AND FIRE DETECTORS
   A. Smoke detectors shall be furnished and installed in each air handling unit or system and detectors shall be furnished by the Division 26 Contractor, installed by the Division 25 Contractor, connected and tested by the Division 26 Contractor.
2.9 SEQUENCE OF OPERATION

A. The operation of the control system shall be as indicated on the drawings and control diagrams. The sequence shall be rewritten and shown on the control submittal drawing diagramming that system. The sequence on the submittal drawing shall identify control devices by number and physical location coordinated with the submittal drawing device numbers.

PART 3 - EXECUTION

3.1 RELAYS

A. All remote field devices shall be controlled through the use of an interposing relay.

3.2 INSTALLATION

A. No control work shall be performed until the control system shop drawings have been approved by the Engineer and returned to the contractor.

3.3 CONTROL WIRING

A. The installation and wiring of all electrical equipment installed under this contract shall meet all Division 16 specifications. Special attention is called to the following:

1. All wiring to be in conduit.
2. All control wiring to be color-coded throughout. Conductor color shall be consistent for the entire length of circuit.
3. All splices shall be made in junction boxes on terminal strips.
4. All control wiring to terminate on marked terminal strips and shall be marked at all terminal points. Both ends of each wire shall be marked with a designation shown on the manufacturer's shop drawings, using interlocking chevron shaped snap-on plastic markers, hot-marked shrinkable tubing, hot stamping of the wire, or clear shrink-on tubing securing adhesive labels. Markers which depend solely on adhesive are not acceptable.

B. Terminal strips shall be used in all boxes and cabinets where more than six control wires are terminated, spliced or both.

C. All control wiring shall be color coded and marked in each box, at each termination with Brady wrap around labels or suitable tags approved by the Architect. The schematic control diagrams shown on the contract drawings are for the convenience of the contractor and may not be complete in all details of control wiring for the equipment purchased for installation.

3.4 SYSTEM TESTING

A. The integrity and accuracy of each function and control point shall be demonstrated to the satisfaction of the Architect/Engineer during the test period. At the termination of the testing period the Contractor shall spend one working day instructing the Owner or his designated personnel in the control system operation. A complete operating booklet shall be provided and used during the training period.

B. Upon completion of the installation, the Contractor or his authorized representative shall be sent to the installation to certify that all necessary electrical tests and control adjustments have
been completed. He shall then file a letter of Certification indicating that the system functions and conforms to the intent of these specifications.

END OF SECTION 253000
SECTION 260000 - ELECTRICAL INDEX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
   A. Furnish all service tools, equipment, etc., which are required for the complete installation of all Electrical Work, as indicated on the Drawings and specified herein. Electrical work indicated on the Drawings and/or specifications covering other trades shall conform to Division 26 of these Specifications.
   B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Electrical systems, shall be accomplished without additional cost to the Owner.
   C. Furnish all labor and materials required for electrical service and control connections to all the various items of equipment requiring electric or wiring service throughout the project shown on the Contract Drawings (even if not shown on the Electrical Drawings). Coordinate with other trades for the installation of required connections and service.

1.3 ELECTRICAL DIVISION INDEX
   260519 LOW VOLTAGE CONDUCTORS
   260526 GROUNDING
   260533 RACEWAYS, BOXES AND FITTINGS
   262416 PANELBOARDS
   262716 CABINETS
   262726 WIRING DEVICES AND PLATES
   262800 MOTOR AND CIRCUIT DISCONNECTS
   262813 FUSES
   265000 LIGHTING EQUIPMENT

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 260000
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
A. Furnish and install all conductors as required for the complete installation and operation of all electrically serviced and/or operated equipment, devices and systems throughout the project.

1.3 RELATED WORK IN OTHER SECTIONS
A. Conduit, feeders, wiring devices and plates, equipment connections, panelboards, transformers, lighting equipment and lamps.

PART 2 - PRODUCTS

2.1 WIRES AND CABLES (600 VOLTS)
A. Type: Conform to the applicable UL and ICEA Standards for the use intended. Copper conductors with 600 volt insulation unless otherwise specified or noted on the drawings. Stranded conductors for No. 6 and larger except where elsewhere specified or noted on the drawings.
B. Use of aluminum conductors will not be permitted.
C. Insulation: Type THWN, 75 degree C. insulation unless otherwise specified or noted on the drawings. 90 degrees C. minimum insulation within fixture wireways of fluorescent fixtures. Where 90 degree C. insulation is specified, the termination points for this conductor shall be rated for 90 degree C.
D. Size: No. 12 minimum unless otherwise specified or noted on the drawings. In the case of "homeruns", no conductor smaller than #10 shall be used for runs over 100 feet in length on 120 volt circuits. Not less than NEC requirements for the system to be installed. If the equipment to be installed requires larger conductor and conduit sizes than indicated on the drawings, the required changes shall be made without additional charge. Remote control wires, other than Class 2 remote control and signal circuits, shall be no smaller than #14.
E. Color Coding: Phase, neutral and equipment ground conductors color-coded. Connect all conductors of the same color to the same phase conductor. Color coding shall be A-black, B-red, C-blue, N-white, for 250 volts or less. A-yellow, B-orange, C-brown, N-off white or grey, for 251-600 volts, with green for all equipment ground conductors. Conductors No. 12 and 10 shall be solid color compounded for the entire length. Conductor sizes larger than No. 10 may be color coded at each termination and in each box or enclosure with six inches of half-lapped 3/4 inch pressure sensitive, plastic tape of respective colors in lieu of solid color compound. The equipment grounding conductor shall be bonded to the outlet box grounding screw with taps to receptacles and equipment. Isolated ground conductors shall be green in color with a yellow trace.
2.2 CONTROL CONDUCTORS
   A. Copper, minimum size No. 14 with 19/35 stranding, color coded filled cross linked polyethylene 75 degree C. 600 volt insulation and neoprene or equal outer jacket. Multi-conductor control cables shall be provided where more than three control conductors are installed in the same conduit between common terminations. Provide two spare conductors minimum in each control cable.

2.3 DATA/COMMUNICATION AND ELECTRONIC CABLE
   A. As required or specified in the section of these specifications specifying the equipment. Splices shall be twisted and soldered or shall use an approved connector.
   B. All Cat. 3 and Cat 5 cabling shall be tested in accordance with EIA/TIA performance standards. Refer to 16740 for more detailed information.

2.4 VERTICAL CABLE SUPPORTS
   A. Split wedge type supports which clamp each individual conductor and tightens due to weight of the cable shall be used for cables without metallic sheath. Basket weave type supports shall be used for cables with metallic sheath.

2.5 CONNECTORS AND LUGS
   A. For Copper Conductors No. 6 and Smaller: 3M Scotch-Lok or T & B Sta-Kon compression or indent type connectors with integral or separate insulating caps.
   B. For Copper Conductors Larger Than No. 6: Solderless, indent, hex screw or bolt type pressure connectors, properly taped or insulated.

2.6 TAPE
   A. Plastic tape, 8.5 mils minimum thickness, 1,000,000 megohms minimum insulation resistance, oil resistant vinyl backing, oil resistant acrylic adhesive, incapable of supporting combustion per ASTM D-568 Test Method B.

PART 3 - EXECUTION

3.1 CONDUIT SYSTEMS
   A. A complete system of conductors shall be installed in the raceway systems. Control wires shall be run in separate conduits from conductors of other systems. All conductors of all systems shall be installed in raceway or conduit.
   B. Lighting fixtures shall not be used as raceways for circuits other than parallel wiring of fixtures. Wiring in fixtures shall be rated for that purpose.
   C. When leaving a metal raceway or conduit in a cabinet, box, switch, enclosure, control enclosure or any other like member, conductors shall be protected by means of insulated bushings or end fittings. These protectors shall be "O.Z." type or similar.
   D. Conductors may be run in multiple sizes #1/0 to 500 kcmil inclusive provided all multiple conductors are the same size, length and type of insulation. Multiple runs are to be in separate conduits. Each conduit to include one set of phase conductors, neutral and grounding conductors. All to conform to NEC 300-20.
E. No splices or taps shall be made in any conductors except in outlet boxes, pull boxes, junction boxes, panelboard boxes, manholes or splice boxes. All taps and splices shall be made with solderless connectors and insulated in such a manner that provides an effective insulation equal to that of the adjoining wire. Any splice or tap shall be made only on conductors which are a component part of a single circuit properly protected by approved methods.

F. Before any wire is pulled into any conduit, the conduit shall be thoroughly swabbed in such a manner as to remove all foreign material and to permit the wire itself to be pulled in a clean, dry conduit. The Contractor shall use only approved wire pulling lubricants for pulling any wire. All conductors shall be pulled into their respective conduits by hand, except where written permission of the Engineer is secured to the contrary.

3.2 WIRE AND CABLE TESTS (600 Volts)
A. Measure the insulating resistance of service entrance conductors, feeder circuit conductors and service ground. Measurements shall be taken between conductors and between conductors and ground. Resistance shall be 1,000,000 ohms or more when tested at 500 volts by megger without branch circuit loads. Tests and procedures shall meet the approval of the Architect/Engineer and shall be in accordance with the applicable IPCEA standards for the wires and cables to be installed. Furnish all instruments, equipment and personnel required for testing and conduct tests in the presence of the Architect/Engineer. Submit written reports of the tests and results when requested.

3.3 PULL WIRES
A. In each empty conduit, except underground conduits, install a No.14 galvanized steel pull wire or a plastic line having a tensile strength of not less than 200 pounds. In each empty underground conduit, install a No. 10 AWG bare, hard drawn copper or copper clad pull wire or a plastic line having a tensile strength of no less than 200 pounds.

3.4 IN RACEWAYS
A. Install conductors in rigid conduit, EMT or flexible metallic conduit, unless otherwise specified or noted on the drawings.

3.5 CABLE BENDS
A. Radius of bends not less than 10 times the outer diameter of the cable.

3.6 BUNDLING
A. In cabinets conductors No. 10 and smaller shall be neatly and securely bundled and conductors larger than No. 10 shall be neatly and securely cabled in individual circuits, utilizing marlin twine, two ply lacing or nylon straps.

3.7 CONDUCTOR PULL
A. Conductors shall not be pulled into conduits until after all plastering or concrete work is completed and all conduits in which moisture has collected have been swabbed out.

3.8 FEEDER IDENTIFICATION
A. Tag feeder circuits in each enclosure with wrap around circuit designation labels where more than one feeder passes through or terminates in the enclosure.
3.9 CONNECTORS AND LUGS

A. Install with manufacturer's recommended tools and with the type and quantity of deformations recommended by manufacturer.

B. Contractor shall review one-line and other Drawings to assure that proper lugs are provided in termination equipment such as switches, panels, switchboards, mechanical equipment, etc. Due to voltage drop conductor sizes and/or numbers may not be accommodated by the equipment affected. If manufacturer cannot provide the proper number and size of lugs within their equipment the Contractor shall provide enclosures and properly sized terminals to convert the oversized cable, number and size that is compatible to the equipment affected.

END OF SECTION 260519
SECTION 260526 - GROUNDING

PART 1 - GENERAL

1.1 RELATED WORK IN OTHER SECTIONS

260519 Low Voltage Conductors
260533 Raceways, Boxes and Fittings
262716 Cabinets
262726 Wiring Devices and Plates
262416 Panelboards

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials, equipment and devices related to the grounding system are specified under other sections of these specifications.

PART 3 - EXECUTION

3.1 GENERAL

A. Install two separate grounding systems, a service grounding system and an equipment grounding system. The service equipment, conduit systems, supports, cabinets, equipment, and neutral conductor shall be grounded in accordance with the minimum code requirements and as further indicated on the drawings or specified. Connect the two grounding systems together only at the main service equipment and at the secondary terminals of transformers creating separately derived distribution systems such as dry-type transformers.

3.2 SERVICE GROUNDING SYSTEM

A. General: The service grounding system is provided for the AC service neutral ground. Current return conductors, such as neutrals of the service entrance, feeder circuits and branch circuits, shall not be used for equipment grounding. Care must be exercised to ensure that neutral bars are not bonded to the enclosures of panelboards, etc., which are not part of the main service equipment. Except for separately derived systems, the neutral conductors shall be grounded only in the main service equipment.

B. Common Ground Point: Establish one common ground point in the main service equipment by interconnecting the insulated neutral bus (or bar), the uninsulated equipment ground bus (or bar), and service grounding electrode conductor.

C. Neutral Disconnecting Means: Install a neutral disconnecting means in the main service equipment for disconnecting and isolating the neutral bus from the common ground. The disconnecting means may be disconnecting links in the interconnection between the insulated neutral and uninsulated equipment ground.
D. Neutral Bars: Provide an insulated neutral bar, separate from the uninsulated equipment ground bar, in all panelboards, transformers, starters, disconnect switches, cabinets, etc. which have neutral connections.

3.3 EQUIPMENT GROUNDING SYSTEM

A. General: Provide a complete equipment grounding system in accordance with the minimum code requirements and as further indicated on the drawings or specified. The equipment ground (green conductor) consists of metallic connections to ground of non-current carrying metal parts of the wiring system or apparatus connected to the system. The primary purpose of equipment grounding is to provide greater safety by limiting the electrical potential between non-current carrying parts of the system and to provide a low impedance path to ground for possible ground fault currents.

B. Common Ground Point: Establish one common ground point as specified elsewhere in this section of the specifications for interconnection of the equipment grounding system and the service grounding electrode conductor.

C. Service Equipment Enclosure: Bond the enclosure of the main service equipment to the uninsulated equipment ground bus (or bar) with a conductor or bar sized for 25% of the largest service overcurrent device.

D. Ground Bar: Provide an uninsulated equipment ground bar, separate from any insulated neutral bar, in all switchboards, panelboards, transformers, motor control centers, starters, disconnect switches, cabinets, etc. for grounding the enclosure and for connecting other equipment ground conductors. The ground bar shall be an integrally mounted and braced bus bar in switchboards or a separately mounted bar adequately braced or bolted to the enclosure of other types of equipment. The ground bar shall be adequately braced or bolted to the enclosure after thoroughly cleaning both surfaces to assure good contact. Provide solderless pressure connectors for all conductor terminations. Number and size of pressure connectors on equipment grounding bars as required for the termination of equipment grounding conductors. In addition to the active circuits, provide pressure connectors for all three-phase spares and spaces.

E. Conduits: Where metallic conduits terminate without mechanical connection to a metallic housing of electrical equipment by means of lock nut and bushings, provide ground bushing connected with a bare copper conductor to the ground bar in the electrical equipment. Metallic conduits containing ground wiring only shall be bonded to the ground wire at both conduit entrance and exit. Install grounding conductor in each nonmetallic conduit or duct except those used for telephone, sound, or low-voltage signals and in all flexible conduit that does not have a built-in ground conductor. Bond the conductor at both ends to the equipment grounding system.

F. Feeders and Branch Circuits: Provide a separate green insulated equipment grounding conductor for each single or three-phase feeder and each branch circuit with a three-phase protective device. Provide a separate green insulated equipment grounding conductor for single phase branch circuits unless otherwise indicated. Install the required grounding conductor in the common conduit or raceway with the related phase and/or neutral conductors and connect to the box or cabinet grounding terminal. Where there are parallel feeders installed in more than one raceway each raceway shall have a green insulated equipment ground conductor.
G. Devices: Install a minimum No. 12 green insulated equipment bonding conductor from a grounding terminal in the respective outlet or junction box to the green ground terminal of all receptacles and through flexible conduit to all light fixture housings.

H. Motors: Install a separate green insulated equipment grounding conductor from the equipment ground bar in the motor control center of separate starter through the conduit and flexible conduit to the ground terminal in the connection box mounted on the motor. Install the grounding conductor in the common conduit or raceway with the related motor circuit conductors.

3.4 SEPARATELY DERIVED SYSTEMS

A. Transformers creating separately derived distribution systems, such as dry-type transformers, shall utilize the equipment ground bars in the transformer enclosure for both secondary equipment ground and secondary neutral ground with separate grounding conductor extended to an approved ground electrode.

3.5 GROUNDING ELECTRODE SYSTEM

A. A minimum of two service ground electrodes shall be utilized. One shall be the main cold water metallic water piping system and the other shall be a made electrode consisting of not less than twenty feet of bare copper conductor encased along the bottom of a concrete foundation footing which is in direct contact with the earth (NEC 250-81c). Make the connections to the cold water pipe inside the building at the point of entrance. Other grounding electrodes (building steel, ground counterpoise, etc.) shall be bonded to the grounding electrode system where utilized. The grounding electrode for separately derived systems shall be approved for the application.

3.6 GROUNDING CONDUCTORS

A. The grounding electrode conductors for the service grounding electrode system shall be insulated or bare copper, sized in accordance with NEC 250-94 (a), including the conductor for the supplemental electrodes. The conductors shall be continuous without joint or splice and shall be installed in conduit with the conduit bonded to the conductor at each end. Install the conductor to permit the shortest and most direct path and terminate in the main service equipment on the common ground point. Equipment grounding conductors shall be green insulated conductors equivalent to the insulation on the associated phase conductor, but not less than Type TW. The equipment grounding conductor or straps shall be sized in accordance with NEC. Where one feeder serves a series of panelboards or transformers, the equipment grounding conductor shall be continuous without splices. Grounding conductors shall not be installed through metal-sheathed holes. All connections shall be available for inspection and maintenance.

3.7 GROUND CONNECTIONS

A. Clean surfaces thoroughly before applying ground lugs or clamps. If surface is coated the coating must be removed down to the bare metal. After the coating has been removed apply a non-corrosive approved compound to cleaned surface and install lugs or clamps. Where galvanizing is removed from metal it shall be painted or touched up with "Galvanox", or equal.

B. All grounding connections to bare stranded wire, ground rods, etc. shall be BURNDY HY-GROUND™ or approved equivalent or approved exothermic connection method. All
connectors shall meet the requirements of IEEE STD 837 (Latest Revision), “IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding”. All connectors must be listed by Underwriters Laboratories for direct burial in earth or embedment in concrete applications according to ANSI/UL-467 (latest revision), “Standard for Grounding and Bonding Equipment.” Connectors must be suitable for lightning protection applications. Listing to UL-96 “Lightning Protection Components” preferred on applicable items.

3.8 TESTS

A. Test the completed grounding system with a megger at the service ground bar and submit a written report to the Architect/Engineer for approval. The service shall not be energized if the test shows more than 5 ohms, unless approved by the Architect/Engineer.

END OF SECTION 260526
SECTION 260533 - RACEWAYS, BOXES AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish and install complete conduit systems for the various electrical systems required for this project. Systems shall be complete with supports, mounting devices, pull boxes, etc., as required for installation of wiring systems and terminal devices.

1.3 RELATED WORK IN OTHER SECTIONS

A. Site work, wiring devices and plates, feeders, panelboards, lighting equipment and lamps, telephone system, transformers and services.

PART 2 - PRODUCTS

2.2 CONDUITS

A. Steel Conduit: Rigid, threaded, thick wall, hot dipped galvanized.

B. Electrical Metallic Tubing (EMT): Mild steel, zinc coated on the outside and either zinc coated or coated with an approved corrosion resistant coating on the inside. Maximum size 2 inch electrical trade size unless noted on the drawings or specifically approved.

C. Intermediate Metal Conduit (IMC): Rigid, threaded, lightweight steel, zinc-coated on the outside and either zinc-coated or coated with an approved corrosion resistant coating on the inside.

D. Flexible Conduit: Commercial "Greenfield," galvanized steel, with a separate grounding bond wire installed in the conduit in addition to other wires.

E. Liquid Tight Flexible Conduit: Flexible galvanized steel tubing with extruded liquid tight PVC outer jacket and a continuous copper bonding conductor wound spirally between the convolutions. Where a separate grounding conductor is installed in the conduit, bonding conductor in the convolutions may be omitted.

F. Plastic coated rigid steel conduit shall be hot dipped galvanized steel conduit with a coating of polyvinyl chloride, minimum 15 mills (0.015), on the exterior surfaces, shall have an approved corrosion resistant coat inside. To be Pittsburgh, J & L, Republic or approved equal. PVC conduits shall include a ground wire sized as noted or as required by NEC (whichever is larger). No bends shall be made in PVC. Rigid galvanized steel conduit shall be utilized for all elbows, risers and bends.

G. Rigid Non-Metallic Conduit: Schedule 40, high impact PVC with 7,000 psi tensile strength at 73.4 degree F., 11,000 psi flexural strength, 8,600 psi compression strength, approved for 90 degree C. conductors. Carlon, triangle, or approved equal. PVC conduits shall include a ground wire sized as noted or as required by NEC (whichever is larger). No bends shall be made in PVC. Rigid galvanized steel conduit shall be utilized for all elbows, risers and bends.

H. Aluminum Conduit: Shall not be used unless specifically indicated on the drawings for specialized purposes.
I. Conduit Size: Minimum conduit size, 1/2 inch except where specifically approved for equipment connections. Sizes not noted on drawings shall be as required by the NEC. All homeruns to panels shall be 3/4 inch minimum. Conduits for #12 THWN wire shall be sized the same as for #12 THW wire.

2.3 CONDUIT FITTINGS

A. Connectors and Couplings: Compression type threadless fittings for rigid steel conduit or IMC not permitted. EMT couplings and connectors either steel or malleable iron only, "Concrete Tight" or "Raintight" and either the gland and ring compression type or the stainless steel multiple point locking type. Connectors to have insulated throats. EMT fittings using set screws or indentations as a means of attachment are not permitted.

B. All conduits shall terminate in bushings or connectors which are insulated type, designed to prevent abrasion of wires without impairing the continuity of the conduit grounding system.

C. Rigid Steel Conduit, IMC and EMT Fittings: Iron or steel only.

D. Liquid Tight Flexible Conduit Fittings: With threaded grounding cone, a steel, nylon or equal plastic compression ring and a gland for tightening. Either steel or malleable iron only with insulated throats and male thread and locknut or male bushing with or without "O" ring seat. Each connector shall provide a low resistance ground connection between the flexible conduit and the outlet box, conduit or other equipment to which it is connected.

E. Rigid Aluminum Conduit Fittings: Malleable iron, steel or aluminum alloy. Ferrous fittings zinc coated or cadmium plated. Aluminum alloy fittings shall conform with the characteristics defined by UL for aluminum rigid metallic conduit and shall not contain more than 0.04 percent copper.

F. Flexible Conduit Fittings (Commercial Greenfield): Either steel or malleable iron only, with insulated throats and shall be one of the following types:
   1. Wedge and screw type with angular wedge fitting between the convolutions of the conduit.
   2. Squeeze or clamp type with bearing surface contoured to wrap around the conduit and clamped by one or more screws.
   3. Steel, multiple point type, for threading into internal wall of the conduit convolutions.

G. Expansion Fittings: Each conduit that is buried in or rigidly secured to the building construction on opposite sides of a building expansion joint and each long run of exposed conduit that may be subject to excessive stresses shall be provided with an expansion fitting. Expansion fittings shall be hot dipped galvanized malleable iron with factory installed packing and a grounding ring.

H. Sealing Fittings: Threaded, zinc or cadmium plated, cast or malleable iron type for steel conduits and threaded cast aluminum type for aluminum conduits. Fittings used to prevent passage of water vapor shall be of the continuous drain type.

I. Fittings for PVC Coated Rigid Steel Conduit: Ells and couplings used with PVC coated rigid steel conduit shall have a factory applied coating of polyvinyl chloride, minimum 15 mills
(0.015) on exterior surfaces and shall have a PVC sleeve extruded a minimum of 2" from one end of the fitting.

2.4 WIREWAYS

A. Square-D Company Square-Duct "lay-in" type without knockouts with lengths and fittings hinged to provide an unobstructed wireway to "lay-in" conductors. Use standard lengths. Field cuts permitted where absolutely necessary. Rust inhibiting phosphatizing coating on sheet metal parts. Blue gray baked enamel finish. Hardware plated to prevent corrosion. Provide all accessories, including tee fittings, junction boxes, cross fittings, transposition section, gusset brackets, nipples, pull boxes, reducer fittings, wall flanges, panel or cabinet flanges, elbows, ceiling and wall support brackets and supporting hardware, etc.

2.5 BUSSED GUTTER

A. Bussed gutter shall be amperage, voltage, and phase configuration as noted on the drawings, with a 50% ground bus. Provide lugs on bus bars as indicated on the drawings. All bus bars shall be copper. Use of aluminum bus bars will not be permitted.

2.6 OUTLET BOXES

A. Construction: Zinc coated or cadmium plated steel boxes of a class to satisfy the condition at each outlet except where unilet or condulet bodies are required. Knockout type with knockouts removed only where necessary to accommodate the conduit entering. Square cornered, straight sided gang boxes, 4 inch octagon concrete rings and 4 inch octagon hung ceiling boxes with bars may be folded type. One piece deep drawn type for all other boxes.

B. Size: To accommodate the required number and sizes of conduits, wires and splices in accordance with NEC requirements, but not smaller than size shown or specified. Standard concrete type boxes not to exceed 6 inches deep except where necessary to permit entrance of conduits into side of boxes without interference with reinforcing bars. Special purpose boxes shall be sized for the device or application indicated.

C. Fixture Studs: 3/8 inch malleable iron fixture stud in outlet boxes for ceiling lighting fixtures and interior bracket lighting fixtures, other than lamp receptacles and drop cords.

D. Exposed: Screw joint type, with gasketed weatherproof covers in locations exposed to the weather. Shall be of the continuous drain type. Where required to be "Raintite."

E. Tile Boxes: Rectangular in shape with square corners and straight sides for receptacles and switches mounted in furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls. Install without plaster rings.

F. Wall Mounted Switch, Receptacle and Signal Boxes: Unless otherwise noted or specified, not less than 4 inches square by 1-1/2 inches deep for single devices, 4-11/16 inches by 1-1/2 inches deep for two devices and multi gang boxes for more than two devices. Boxes for switches and receptacles on unfinished walls may be screw joint type with covers to fit the devices. Provide plaster rings, as required, to provide proper opening for device.

G. Wall Mounted Telephone Outlet Boxes: 4-11/16 inches square by 2-1/8 inches deep, unless otherwise noted on the drawings.
H. Light Fixture Boxes: 4 inch diameter by 1.5 inch deep minimum for ceiling and interior bracket fixtures with concealed conduits. Plaster covers for bracket fixtures to have 3 inch diameter openings. Screw joint boxes with canopy seat for ceiling and interior bracket fixtures with exposed conduits.

I. Grounding Terminal: Provide a grounding terminal in each box with circuits serving motor driven equipment or receptacles for grounding to a green equipment ground conductor. Grounding terminal shall be green colored washer-in-head machine screw.

2.7 PULLBOXES

A. Minimum NEC requirements unless larger box is noted. As specified for outlet boxes with blank cover for pullboxes with internal volume not more than 150 cubic inches. As specified for cabinets for pullboxes with internal volume over 150 cubic inches, except covers to have same thickness as box with corrosion resistant screw or bolt attachment.

2.8 FLOOR BOXES

A. Heavy duty, cast, adjustable type, suitable for the device or application indicated, unless noted. Provide carpet flanges in carpet areas.

PART 3 - EXECUTION

3.2 CONDUIT INSTALLATION

A. Conduit Systems: Conduit shall be provided for all wiring circuits. Material shall be exposed or concealed as required by the Drawings. Rigid Steel conduit, IMC, EMT or Rigid Non-Metallic conduit unless noted. Install rigid steel conduits for underground runs, when specifically noted on the drawings, runs in concrete, feeder circuits and where required by the NEC for mechanical protection, etc. Use flexible conduit only for equipment connections and then only to the extent of minimum lengths required for connections (Typically 1'-0", maximum length 4'-0"). Install flexible conduit connections at all resilient mounted equipment. Provide liquid tight flexible conduit in exterior, wet or damp locations and for connections to all motors, dry type transformers and wet pipe mechanical systems. Aluminum conduit may be used only if specifically called for. Conduit and tubing shall be kept at least 6 inches from parallel runs of hot water or steam pipes. PVC conduit may be used only for runs below grade or in slab. Concrete encasement is required under all paved areas. Rigid steel, galvanized elbows shall be used for all bends and risers. No PVC shall be extended above grade or slab. Ground wires, sized in accordance with NEC, shall be installed in all conduit runs, except where used for telephone conductors.

B. Conduit Installation: Install concealed conduit and EMT in as direct lines as possible. Install exposed conduits and EMT parallel to or at right angles to the lines of the building. Right angle bends in exposed conduit and EMT runs shall be made with standard elbows, screw jointed conduit fittings or conduit bent to radii no less than those of standard elbows. Exposed conduits below the five (5) foot level shall be galvanized rigid conduit.

C. Concealed Conduits: Install conduit systems concealed where possible unless otherwise noted. Conduit systems may be exposed in unfinished utility areas, ceiling cavities and where
specifically approved by the Engineer. No conduit shall be run on roof or exposed face of building unless specifically shown on plans or approved by Engineer.

D. Conduit in Concrete: Conduits shall not be installed in floor slabs poured on grade. Conduits under slab shall be installed a minimum 6” below slab, covered with earth. PVC coated rigid steel conduit may be embedded in above grade concrete providing the outside diameter does not exceed 1/3 thickness of concrete slab, wall or beam, is located entirely within the center third of the member and lateral spacing of conduit is not less than 3 diameters.

E. Conduit in Ground: PVC schedule 40 non-metallic conduit may be utilized for all underground runs unless noted otherwise on the drawings. Installation and use of PVC shall comply with Article 347 of NEC. All conduit sizes, shown on the plans, shall be increased to accommodate the installation of the equipment grounding conductor. All joints shall be made with solvent cement per manufacturer's recommendations and shall be watertight. Plastic conduit runs stubbing up to above grade junction boxes or conduit runs shall be converted to PVC plastoid coated rigid steel conduit by installing a female adapter, 90 degree PVC coated rigid steel elbow and a PVC coated rigid steel nipple of length as required to stub conduit up. No plastic conduit shall be installed above grade. Plastic conduit shall be used for straight runs only. PVC coated rigid steel conduit shall be used for all bends, ells and offsets. Where rigid galvanized steel conduit is in contact with dirt, soil, fill or earth, conduits shall be field wrapped with one layer of 3M Scotch 50 plastic tape with a 50% overlap, including all joints or couplings, or shall be coated with a bonded, 20 mil minimum thickness PVC, permanently fused at the factory, Pittsburgh Standard Co. "PlastiBond," or approved equal. All fittings, couplings, ells, etc., used with PVC coated conduit shall have same factory applied PVC coating. An equipment grounding conductor, in accordance with NEC, shall be installed in all conduits. Minimum burial depth of conduits or ducts shall be as follows:

   Power: Primary (above 600v.), 42"
   Secondary (below 600v.), 36"
   Telephone: 24"

F. Conduit Bends: In any conduit or EMT run, the number of quarter bends or equivalent between terminations at cabinets or boxes shall not exceed four bends. Conduit runs between cabinets or boxes shall not exceed 200 feet for straight runs nor 100 feet for runs with maximum number of bends. Bends in telephone and data conduits shall be long sweeping bends.

G. Conduit Openings: Protect all vertical runs of conduits or EMT terminating in the bottoms of boxes or cabinets, etc., from the entrance of foreign material prior to installation of conductors.

H. Roof Penetrations: All roof penetrations shall be sealed as called for in the architectural plans and specifications.

I. Pull Cords: The Contractor shall furnish and install a full length, 3/32" nylon pull cord in every "empty" conduit installed hereunder to facilitate the future installation of wires. Identify each terminus of pull wire with linen tags with complete information as to service and location of the terminus of the cord.

J. Sealing Fittings: Install where required by the NEC, where conduits pass from warm to cold locations and where otherwise indicated.
K. Sleeves for Conduit: Install sleeves for conduit where shown or as required. Conduit sleeves not used shall be plugged with recessed type plugs. Sleeve all conduit passing through walls. Sleeves that are used shall be caulked tight with lead yarn.

L. Identification: Identify all exposed raceways according to the system carried. Identify exposed conduits 3/4 inch or larger in diameter by means of painted-on stencils, and conduits less than 3/4 inch in diameter with enameled-on metal tags. Provide legible lettering in contrasting colors. Abbreviate only when approved. Identification shall be placed at maximum intervals of twenty feet on straight conduit runs, close to all terminations, adjacent to all change in directions and where conduits pass through walls or floors. In general, use yellow color. Painting shall be in accordance with DIVISION 9 - FINISHES.

3.3 CONDUIT SUPPORTS

A. Supports: Provide supports for horizontal conduits and EMT not more than 8 feet apart with not less than two supports for each 10 foot straight length and one support near each elbow or bend including runs above suspended ceilings and within 3 feet of all junction boxes, switches, fittings, etc.

B. Straps: Install one hole pipe straps on conduits 1.5 inch or smaller. Install individual pipe hangers for conduits larger than 1.5 inch. Spring steel fasteners with hanger rods may be used in dry locations in lieu of pipe straps.

C. Trapezes: Install multiple (trapeze) pipe hangers where two or more horizontal conduits or EMT run parallel and at the same elevation. Secure each conduit or EMT to the horizontal hanger member by a U-bolt, one hole strap or other specially designed and approved fastener.

D. Hanger Rods: Install 1/4 inch diameter or larger galvanized steel rods for trapezes, spring steel fasteners, clips and clamps. Wire or perforated strapping shall not be used for the support of any conduit or EMT.

E. Fastening: Fasten pipe straps and hanger rods to concrete by means of inserts or expansion bolts to brickwork by means of expansion bolts and to hollow masonry by means of toggle bolts. Wooden plugs and shield shall not be used. Power driven fasteners may be used to attach pipe straps and hanger rods to concrete only where approved by the Engineer.

F. All conduits not embedded in concrete shall be firmly secured by means of pipe clamps, hangers, etc., equal to Caddy fasteners of ERICO Products, Inc. Wire wrapped around conduits and supporting members will not be accepted.

G. On Roof: All conduits laid on roof shall be supported on 4" redwood blocks, mopped into roof and spaced at 5'-0" on center.

H. Lay-in Ceiling: Conduits routed above acoustical "lay-in" ceilings shall be anchored to the building structure and not laid on the ceiling. Wire shall not be used to anchor boxes to structure. If ceiling support system is adequate, one 3/4" maximum conduit may be supported by a Caddy Clip to hanger wire. Multiple runs of conduit shall be racked on trapeze hanger. All support materials shall be rustproof. Perforated tape or soft iron wire shall not be used.
3.4 CONDUIT STUB-UPS
A. Conduits run under floor shall be stubbed up to a coupling set flush with floor. This excludes conduits stubbed up in walls and feeder conduits. Install flush plug until after floor is finished, then complete connections to boxes or equipment.

3.5 OUTLET BOXES
A. Outlet Boxes: Outlet boxes, covers and fittings, according to the particular use for which they are required, shall be provided in the locations marked on the drawings by symbols, and/or for use to facilitate the installation of the electrical systems. When necessary, outlets shall be relocated so that when fixtures of other fittings are installed they will be symmetrically located according to the room layout and will not interfere with other work or equipment required by the drawings and/or specifications.

B. Installation: Unless otherwise specified or shown on the drawings, outlet boxes shall be flush mounted and the front edges of the boxes or plaster covers shall be flush with the finished wall or ceiling line or if installed in walls and ceilings of incombustible construction, not more than 1/4 inch back of same. Mount boxes with the long axes of devices vertical, unless otherwise specified. Boxes in plastered walls and ceilings shall be provided with plastic covers. A multiple of box extensions and/or covers will not be permitted. Install in a rigid and satisfactory manner with suitable metal bar hangers, box cleats, adjustable box hangers, etc. Use wood screws on wood, expansion shields on masonry and machine screws on steel work.

C. Mounting Heights: The mounting height of a wall mounted outlet box shall be construed to mean the height from the finished floor to the horizontal center line of the cover plate. On exposed tile, block or brick construction, mount outlet boxes at the nearest bed joint to the mounting height indicated. Wall Mounted Switch, Receptacle and Signal Outlets: On columns, pilasters, etc., mount so the centers of the columns are clear for future installation of partitions. Install outlet boxes near doors or windows close to trim. Install outlet boxes near the doors on the lock sides (see architectural drawings for correct door swings).

D. Identification: Identify all exposed junction boxes according to the system carried by means of painted-on stencils or labels with legible letters and contrasting colors and without abbreviations. In general, use yellow color. Painting shall be in accordance with DIVISION 9 - FINISHES.

3.6 PULLBOXES
A. Provide additional pullboxes wherever necessary to meet requirements for maximum length of conduit runs and maximum numbers of bends.

3.7 FLOOR BOXES
A. Install level with top covers adjusted flush with finished floor or floor tile.

3.8 FIXTURE CONNECTIONS
A. Recessed or surface light fixtures in lay-in or accessible ceilings shall be connected with minimum 1/2 inch flexible metallic conduit, 4 to 6 feet long with grounding provisions.
3.9 CLOSING OF OPENINGS

A. Wherever slots, sleeves or other openings are provided in floors or walls for the passage of conduits or other forms of raceway, such openings, if unused, or the spaces left in such openings, shall be filled or closed in an approved manner.

3.10 IDENTIFICATION

A. Refer to Section 260500 - General Electrical Provisions for identification requirements for raceways and boxes.

END OF SECTION 260533
SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
   A. Furnish and install complete, all panelboards.

1.3 RELATED WORK IN OTHER SECTIONS
   A. Cabinets; Motor & Circuit Disconnects; Fuses; Service and Distribution; Grounding; Conductors, Raceways, Boxes and Fittings.

1.4 SUBMITTALS
   A. Submit complete shop drawings with outline dimensions, descriptive literature and complete descriptions of the frame size, trip setting, class and interrupting rating of all overcurrent devices. Identify available spaces. Complete description of physical layout of panelboards showing conformance with drawings.

PART 2 - PRODUCTS

2.1 GENERAL
   A. Dead front, safety type, with voltage and amperage ratings as scheduled. Panelboards shall be of the type required for the short circuit and duty ratings indicated on the drawings or specified. All panelboards shall have a neutral bus and an insulated ground bus. Panelboards shall be as manufactured by General Electric, Cutler-Hammer or Square D and shall be as scheduled.

2.2 CABINETS
   A. Each panelboard shall be enclosed in a sheet metal cabinet with front doors, catches, locks, etc., as specified in Section 262716, Cabinets.
   B. Door-in-Door: Both surface and flush panels shall be door-in-door. The door over the interior of the panel shall be provided with hinges and combined lock and latch. The outside door over the panel gutters shall be provided with hinge(s) on one side and combined lock and latch. Machine screws into threaded holes in the panelboard cabinet, in lieu of combined lock and latch, to secure the outside door are not acceptable.

2.3 FUSIBLE PANELBOARD
   A. Fusible panelboards shall be factory assembled. Each fused switch shall have an etched micarta nameplate secured by two cadmium plated screws. The panelboard shall have a neutral bus and a ground bus connected with a removable link.

   General Electric "QMR" up to 1200 amps
   Square D "QMB" up to 1200 amps
B. Quick-make, quick-break fusible switch units to be of type with external operating handle suitable for padlocking in OFF position. Provide interlock to prevent opening cover when switch is in ON position unless interlock release is operated. Provide frame and fuse clip ratings as indicated in the panelboard schedules. Switch and fuse holder shall be rated for 200,000 amp interrupting capacity. Fuse holders shall be provided with Class R rejection feature.

C. Fuses shall be provided for all switches. Fuses for switches serving motors shall be Bussman Fusetrons, sized for heavy service motor running protection. Fuses for other services shall be as designated on the drawings. Proper fuse amp ratings shall be indicated on inside of switch cover, through the use of "Tapewriter" and should read "Use Fusetrons Only" (indicate amperage size as shown on plans).

D. Space Only: Where "space only" in noted on the drawings, provide necessary connectors, mounting brackets, etc., for the future insertion of an overcurrent device. Spaces shall be sized 200 amps unless noted otherwise.

2.4 CIRCUIT BREAKER PANELBOARDS

A. Panelboard interiors shall be constructed on pre-drilled and tapped channel rails. Main busses shall be pre-drilled and tapped to accommodate any combination of circuit breaker units without further modification. All panelboards shall be complete with doors. Units shall be complete with combination latch and cylinder locks. All locks shall be keyed alike. All bussing shall be of the "sequence type". All connections shall be bolted.

B. Circuit breakers shall be molded case type (minimum 10,000 amp interrupting capacity, larger as required). All multi-pole breakers shall have a common trip and all breakers shall be interchangeable in any combination of poles with the same frame size. All branch circuit straps shall have the capacity of the maximum breaker size in the frame space (i.e. 100 amp strap for 100 amp frame). Minimum 100 amp straps will be accepted.

C. All main and branch breakers shall be of the size and have the interrupting rating scheduled on the Drawings. All incoming and outgoing terminals shall have solderless lugs. Provide, where required, lug landing to accommodate number and size conductors shown on the Power Riser. Panelboards shall be factory assembled.

D. Single pole circuit breakers shall be suitable for switching duty and marked "SWD".

E. Bolted Type: Circuit breaker current carrying connections to the bus shall be of the bolted type, factory assembled. Stab in type not permitted. Provide bus bars for three phase panelboards of the sequence phased type connection and arranged for 3 phase, 4 wire mains, unless otherwise indicated on the drawings.

F. Space Only: Where "space only" is noted on the drawings, provide necessary connectors, mounting brackets, etc., for the future insertion of an overcurrent device. Provide blank cover for each space.

G. Directories: Provide typewritten circuit descriptions referencing permanent room numbering assigned in lieu of the room numbering shown on the drawings.
H. Spare Conduit: Provide three spare 1" conduits for each panel. Extend empty conduit with pullwire into accessible ceiling space and stub-out for future use.

2.5 NAMEPLATE
A. Labels for identifying the breakers shall be engraved laminated plastic strips attached by screws (see "Nameplates" Specifications in Section 260500) or labels supplied by Panel Manufacturer.
B. Nameplates on Panelboards shall give voltage characteristics phase and number of wires. Example: Panel A, 120/208V, 3 phase, 4W.
C. Individual circuit breakers or switches, panelboards, disconnect means and motor starters shall have nameplate showing the load served.
D. Blank name plates shall be mounted on each "spare" unit or on "space" in distribution panels.

2.6 SKIRTS
A. Where noted on the drawings panelboards shall be skirted with complete metal enclosures and barriers separating the panel interior.

2.7 BUS BARS
A. All bus bars shall be copper. Use of aluminum bus bars will not be permitted.

2.8 CONNECTORS AND LUGS
A. Contractor shall review one-line and other Drawings to assure that proper lugs are provided in termination equipment such as switches, panels, switchboards, mechanical equipment, etc. Due to voltage drop conductor sizes and/or numbers may not be accommodated by the equipment affected. If manufacturer cannot provide the proper number and size of lugs within their equipment the Contractor shall provide enclosures and properly sized terminals to convert the oversized cable, number and size that is compatible to the equipment affected.

PART 3 - EXECUTION
3.1 PANELBOARDS
A. Panelboards shall be located where indicated on the drawings. Panelboards shall have neatly typed circuit directories behind clear plastic. Identify circuits by area designations and use. "Spare" and "Space" shall be indicated with erasable pencil, not typed.
B. Circuiting of all branch circuits shall be as designated on the drawings. Breaker and switch arrangement in panels shall be exactly as specified and all circuits will terminate in the positions indicated.

3.2 PHASE ROTATION
A. Phase A, left bus; phase B, center bus; phase C, right bus (front viewing).

END OF SECTION 262416
SECTION 262716 - CABINETS

PART 1 - GENERAL
1.1 RELATED DOCUMENTS
   A. The general provisions of the Contract, including General and Special Conditions and General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
   A. Furnish and install cabinets for panelboards, telephone, and communication systems as required.

1.3 RELATED WORK IN OTHER SECTIONS
   A. Panelboards, sound systems, telephone systems.

PART 2 - PRODUCTS
2.1 GENERAL
   A. Sheet steel code gauge, galvanized cabinets with painted fronts and trim. Those exposed to wet or rain conditions shall be "raintight" unless otherwise noted. Cabinets without through feeder wiring shall be arranged to provide a wiring gutter not less than 4 inches wide for branch circuit panelboards served by feeders up to 4/0. Panelboards served by feeders in excess of 4/0, up to and including 750 kcmil, shall be provided with top, bottom and side gutters 8 inches wide. Cabinets shall be of standard make and shall bear the Underwriters Laboratories label. All outside surfaces of trim and doors shall be given a factory finish coat of No. 61 ANSI gray paint, or approved manufacturer's standard. Cabinets for telephone and communications systems shall have 5/8 inch exterior grade, one-face B-grade or equal flame proofed plywood backboard inside with maximum height and width.

2.2 FEED-THROUGH GUTTERS
   A. Where feeders go through panelboard cabinets to serve panelboards above or beyond, the wiring gutters in panelboard cabinets shall be a minimum of 8 inches on sides, top and bottom.

2.3 TRIM
   A. One-piece, sheet steel trim with hinged door with catch and lock. One piece sheet steel with 3/4 inch flange around all edges shaped to cover edge of box. For telephone or communication cabinets trims with captive nuts or clamps. Trims shall be furnished with indicating adjustable trim clamps for panelboards.

2.4 DOORS
   A. Doors shall close against a rabbet placed all around the inside edge of the frame with a close-fitting joint between door and frame. The doors shall be fitted with substantial flush hinges placed not over 24 inches apart, nor more than six inches from ends of doors, and fastened permanently to the door and frame with round-headed rivets or spot welds, or with concealed flush piano hinges. Fastening screws or clamps or trims shall be set not over 24 inches apart. Doors over 48 inches in height shall be equipped with a vault handle and a three-point catch.
2.5 LOCKS

A. Furnish each cabinet with a combination catch and flat key lock. The telephone, electrical and signal cabinet locks shall be fitted to separate keying for each system. Furnish two keys for each cabinet.

2.6 GROUND BAR

A. Each cabinet, for a panelboard, shall be provided with a copper interior ground bar suitably braced or bolted to the cabinet wall. The equipment ground bar shall be equivalent in current carrying capacity to the incoming feeder ground conductor and shall have approved pressure connector terminations for the associated feeders, branch circuits, etc.

PART 3 - EXECUTION

3.1 CABINETS

A. Cables installed in the wiring gutters of cabinets shall be neatly bundled, routed and supported. Minimum bending radii as recommended by the cable manufacturer shall not be reduced. Lighting and power cabinets shall be installed with tops 6'-6" above floor and bottoms not less than 12 inches above floor.

END OF SECTION 262716
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. The general provisions for the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
A. Furnish and install all wiring devices and plates as required for the complete installation and operation of all systems throughout the project.

1.3 RELATED WORK IN OTHER SECTIONS
A. Conductors, Conduit, Boxes and Fittings.

PART 2 - PRODUCTS

2.1 WALL SWITCHES
A. Unless otherwise specified, each wall switch (flush tumbler-toggle) shall be of the A.C. General use type for mounting in a single gang spacing, fully rated 20 amperes minimum at 120/277 volts, conforming to minimum requirements of the latest revision of the Underwriter's Laboratories, Inc., UL 20 Fifth Edition Standard Snap Switches and further requirements herein specified. Specification grade, heavy duty, single pole, 3-way or 4-way, of the maintained, momentary or lock type as indicated on the drawings. Switches shall operate in any position and shall be fully enclosed cup type with entire body of molded phenolic, urea or melamine with cover of molded phenolic, urea or melamine. Fiber, paper or similar insulating material shall not be used for body or cover. Ivory color handles unless otherwise indicated. Silver or silver alloy contacts. A.C. 120/277 volt general use snap switches shall be capable of withstanding tests as outlined in NEMA Publications and shall be as follows unless otherwise noted:

<table>
<thead>
<tr>
<th>Switch</th>
<th>Hubbell</th>
<th>P &amp; S</th>
<th>AH &amp; H</th>
<th>Bryant</th>
<th>Leviton</th>
</tr>
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<tbody>
<tr>
<td>1P</td>
<td>1221-I</td>
<td>20-AC-1-I</td>
<td>1991-I</td>
<td>4901-I</td>
<td>1221-I</td>
</tr>
<tr>
<td>3-Way</td>
<td>1223-I</td>
<td>20-AC-3-I</td>
<td>1993-I</td>
<td>4903-I</td>
<td>1223-I</td>
</tr>
<tr>
<td>4-Way</td>
<td>1224-I</td>
<td>20-AC-4-I</td>
<td>1994-I</td>
<td>4904-I</td>
<td>1224-I</td>
</tr>
<tr>
<td>3-pos. 2 cct</td>
<td>1385-I</td>
<td>1225-I</td>
<td>4361-I</td>
<td>4922-I</td>
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<tr>
<td>maintained</td>
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<tr>
<td>3-pos. 2 cct</td>
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<td>1251-I</td>
<td>1995-I</td>
<td>4921-I</td>
<td></td>
</tr>
<tr>
<td>momentary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lighted handle</td>
<td>1221-PL</td>
<td>2251-SP</td>
<td>2999-R</td>
<td>4901-PL</td>
<td>1220-PL</td>
</tr>
<tr>
<td>pilot lgt.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.2 RECEPTACLES
   A. General: Configuration and requirements for all connector or outlet receptacles shall be in accordance with NEMA Publications. Fire resistant, non absorptive, hot welded, phenolic composition or equal bodies and bases with metal plaster ears (integral with the supporting member). Single or duplex as shown or noted on drawings. Ivory color unless otherwise noted on the drawings. Double grip contacts for each prong.
   B. Grounding Type: All receptacles shall be grounding type with a green colored hexagonal equipment ground screw of adequate size to accommodate an insulated grounding jumper (based on Table 250-95 of the NEC with minimum size No. 14 AWG). Grounding terminals of all receptacles shall be internally connected to the receptacle mounting yoke. Unless otherwise noted, receptacles shall be as follows:

<table>
<thead>
<tr>
<th>Receptacle</th>
<th>Hubbell</th>
<th>P &amp; S</th>
<th>AH &amp; H</th>
<th>Bryant</th>
</tr>
</thead>
<tbody>
<tr>
<td>20A-125V AC 2P 3W</td>
<td>5362-I</td>
<td>6300-I</td>
<td>5739-I</td>
<td>5362-I</td>
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<tr>
<td>20A-208V AC 4P 4W</td>
<td>7250</td>
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<td>7250</td>
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<tr>
<td>30A-250V AC 3P 3W</td>
<td>9350</td>
<td>3853</td>
<td>9344</td>
<td>9303</td>
</tr>
<tr>
<td>30A-600V AC 4P 4W</td>
<td>3430</td>
<td>3430</td>
<td>LD3430</td>
<td>3430</td>
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<tr>
<td>Clock</td>
<td>1544</td>
<td>5708</td>
<td>4224-5</td>
<td>2828GS</td>
</tr>
<tr>
<td>Special</td>
<td>Receptacles for special applications shall be as indicated on the drawings.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.3 PLUG CAPS
   A. Except for duplex receptacles, and cleaning combination receptacles one matching plug cap shall be provided for each receptacle. No plug caps are required for duplex receptacles. Provide watertight, male plug caps in damp locations or where exposed to weather.

2.4 DEVICE PLATES
   A. General: Provide plates for each switch, receptacle, signal and telephone outlet and special purpose outlet. Do not use sectional gang plates. Provide multi gang outlet plates for multi gang boxes. All plates on finished walls shall be Leviton #84000-40 series, stainless steel. Screws shall be of metal with countersunk heads with finish to match the finish of the plate. Device plates shall be of the one-piece type, of suitable shape for the device to be covered. Where specifically noted as "plastic" plates on the drawings, plates shall be Leviton White #88000 (85000 Brown, 87000 Grey, 86000 Ivory, if noted). Devices in this case shall match, in color, the plastic plates.
   B. Exposed: Plates for exposed screw jointed fittings shall match the fittings with edges of plates flush with edges of fittings. To be heavy cadmium plates, steel, with gasket. Plates for cast type boxes at locations subject to wet or rain conditions, shall be of the cast, vapor tight type. Provide hinged lift covers for devices.
   C. Communications: Plates for telephone and signal outlets shall each have a 3/8 inch bushed opening in the center. Wall plates for push button and buzzer outlets shall have openings to suit the push buttons and buzzers.
D. Plates for special purpose outlets shall be of a design suitable for the particular application.

2.5 CLOCK OUTLETS
A. Flush, single receptacle, regressed in stainless steel device plate.

2.6 REMOTELY CONTROLLED SWITCHES OR RELAYS
A. Electro-magnetically operated, mechanically held with clearing contacts for maintained contact control unless otherwise required. Rugged construction conforming to NEMA and IEEE test standards for industrial type power relays and the requirements of UL 508, Standards for Safety Industrial Control Equipment. Ratings as indicated on the drawings suitable for the application. Contacts shall be double break renewable, solid wiping type, silver-to-silver Tungsten alloy, self-aligning, quick-make, quick-break, with a minimum inductive load rating of 20 amps. Relays shall be as manufactured by Allen-Bradley, Cutler-Hammer, General Electric, Square D or Westinghouse, equal to Allen-Bradley Bulletin 700 Control Relays. Provide sound deadening mounting and enclosure.

2.7 MOMENTARY CONTACT SWITCHES
A. Tumbler type single pole double throw momentary contact for 3 wire circuit, with Off position when tumbler handle is in the center, similar in appearance to the conventional snap switch. Handle or key operated as indicated on drawings. 15 ampere at 120/277 volts for control of 30, 60, or 100 ampere remotely controlled switches or relays rated 101 amperes and above. Provide nameplate to identify the circuit or equipment controlled.

PART 3 - EXECUTION
3.1 OUTLET LOCATIONS
A. Shall be as indicated on the drawings. Align devices and plates horizontally and vertically.
B. It shall be the responsibility of the Contractor to determine from the architectural drawings and by actual determination on the site, the exact location of each and every outlet. The outlet locations shall be modified from those shown on the plans to accommodate changes in door swings or to clear other interferences that may arise from job construction details as well as modifications within room spaces. These modifications shall be made with no change in contract price and shall be a matter of job coordination at the expense of the Contractor. The Contractor shall check these conditions throughout the entire job and shall notify the Architect/Engineer of discrepancies as they occur before proceeding with the installation of the work to verify the modifications, if any. Wall boxes shall be set in advance of wall construction, shall be blocked in place and secured. All wall boxes shall be set flush with finished building construction and the Contractor shall furnish and install extension sleeves as required to extend boxes to the finished surfaces of special furring. No switches shall be located behind doors without specific written authorization by the Architect.

3.2 YOKES
A. Wiring device yokes shall be installed in physical contact with the plaster ring. Where the above contact cannot be obtained, a green covered bonding conductor shall be installed.
3.3 PLATES
   A. Shall be installed with all four edges in continuous contact with finished wall surface without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed vertically and with an alignment tolerance of 1/16".
   B. Device cover plates for each and every device shall be furnished and installed by this Contractor.

3.4 RECEPTACLES
   A. Shall have a separate ground wire from the grounding screw to a grounding stud in the outlet box. All receptacles shall be installed with the "U" slot in the upper position. Substitutions for duplex convenience outlets as listed in 16140 - 2.2 shall only be considered if rated as “Specification Grade”.

END OF SECTION 262726
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
   A. Furnish and install complete motor and circuit disconnects for various items requiring them for this project.

1.3 RELATED WORK IN OTHER SECTIONS
   A. Conductors, motors, motor starters, panelboards, grounding.

PART 2 - PRODUCTS

2.1 DISCONNECTING MEANS
   A. Safety Switches: Fusible Type HD quick break safety switches of the sizes and capacities indicated or required. NEMA 4 Raintight enclosures at locations exposed to the weather.
   B. Separately Enclosed Motor Snap Switches: Motor snap switches may be used for motor disconnect means, controller and motor overcurrent protection when applicable. These devices shall be horsepower rated and shall contain motor running overcurrent protection.

2.2 SAFETY TYPE DISCONNECTING SWITCHES
   A. Heavy duty, quick make, quick break type, 250, 480 or 600 volt rating as required for the application. Number of poles and amperage as noted or required for application, or required by code. Fusible with fuse clips suitable for Buss fuses. Short circuit rating of 200,000 RMS Amperes with Class R rejection feature installed in fuseholders. NEMA 1 enclosures for dry locations. NEMA 4 enclosures for wet locations or where exposed to weather unless otherwise noted.
   B. Fuses shall be provided for all switches. Fuses for switches at motors shall be Bussman Fusetrons, sized for heavy service motor running protection. Fuses in other locations shall be as designated on the drawings or indicated in Section 262813 of these specifications. Proper fuse amp ratings shall be indicated on inside of switch cover, through the use of "Tapewriter" and should read "Use Fusetrons Only" (indicate amperage size as shown on plans). See Section 262813 for other labeling requirements.

PART 3 - EXECUTION

3.1 DISCONNECT MEANS
   A. Install in each location indicated on the drawings and elsewhere as required by NEC.
B. Switches installed outdoors shall be raintight and shall be suitably supported, independently of the item to be served (by unistrut rack) unless sufficient unobstructed flat surface exists on the unit to properly support the electrical equipment.

END OF SECTION 262800
SECTION 262813 - FUSES

PART 1 - GENERAL
1.1 RELATED DOCUMENTS
   A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
   A. Furnish and install all fuses required for the various electrical systems required for this project.

1.3 RELATED WORK IN OTHER SECTIONS
   A. Panelboards, motor and circuit disconnects

PART 2 - PRODUCTS
2.1 FUSES
   A. General: Dual element, time delay type, based on heavy service, Buss Fusetron, or equal, unless otherwise noted or required for installation. For individual motor circuit protection, provide fuse sized approximately 125 percent of full load current with 200,000 amperes interrupting capacity.
   B. Current-Limiting Fuses: Provide where indicated on the drawings. For non-motor feeder protection in conjunction with fused switches, install NEMA Class L or K Buss Limitron fuses sized 125 percent of load current or as required for coordination with air and molded case circuit breakers.
      1. Above 600 amps: Class L, "Hi-Cap" as manufactured by Bussman.
      2. Below 600 amps, as required by short circuit duty, Class RK-1, "Limitron" or Class RK-1, "Low Peak" or Class RK-5, "Fusetron" as manufactured by Bussman.
      3. All switches having current limiting fuses installed shall have a Lamicoid nameplate with white lettering on red background reading:
         WARNING, REPLACE ONLY WITH CURRENT LIMITING FUSES AS ORIGINALLY INSTALLED
   C. All fuses shall be rated 200,000 AIC and be of the rejection feature type.

2.2 COORDINATION
   A. Coordinate the low voltage fuses required for the project to provide basic selective protection and properly coordinate with the other associated protective equipment.

2.3 FUSE CABINET
   A. Provide one wall mounted cabinet for storing all spare fuses. The cabinet shall have a hinged door with latch, with the word "FUSES" stenciled on the front.
PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate the low voltage fuses required for the project to provide basic selective protection and properly coordinate with the other associated protective equipment.

3.2 SPARE FUSES

A. Furnish one complete spare set (3) of each size and type of fuse required on this project for panelboards, safety switches, and switchboards. Deliver to Owner in the original boxes and store in the fuse cabinet furnished under this Contract.

END OF SECTION 262813
SECTION 265000 - LIGHTING EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS
   A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK
   A. Furnish and install all lighting equipment and lamps as scheduled on the drawings and as specified herein.

1.3 RELATED WORK IN OTHER SECTIONS
   A. Conduit, boxes and fittings, conductors, wiring devices and plates, acoustic ceilings.

1.4 SUBMITTALS
   A. Submit for approval complete shop drawings, catalog cuts, special installation instructions, photometric data and descriptive literature.

PART 2 - PRODUCTS

2.2 GENERAL
   A. Furnish all lighting fixtures, of the type indicated on the drawings, complete with lamps, sockets, wiring, fitters, hangers, plaster rings, canopies, etc., as required.

2.3 LAMPS
   A. LED lamps will meet the requirements as specified by the manufacturer and model number in the fixture schedule on the drawings.
   B. T8 lamps, medium bipin base, correlated color temperature of 3500K with a color rendering index (CRI) of 75. They are to operate on ballasts specifically designed for 265 ma., T8 lamps.
   C. Incandescent lamps shall be inside frosted, medium base, extended service, 130 volt unless otherwise noted. PAR or R lamps shall be provided where called for on the drawings or required by specified fixture type.
   D. Mercury vapor lamps shall be Deluxe warm white phosphor coated, mogul base with correlated color temperature of 3900 K.
   E. Metal Halide lamps shall be phosphor coated, mogul base with correlated color temperature of 4000 K. Lamps shall be furnished for proper lamp burning position.
   F. High-pressure sodium lamps shall be clear, mogul base with an apparent color temperature of 2100 K. Lamps shall be furnished for proper lamp burning position.
   G. Safety: All Mercury vapor and Metal Halide lamps shall be furnished with a means of immediately extinguishing the lamp when the outer lamp envelope is either penetrated or broken.
   H. Manufacturers: General Electric, Sylvania, Westinghouse, or an approved equal.
2.4 BALLASTS

A. Fluorescent ballasts shall be electronic type. All ballasts supplied shall optimize the performance of the specific lamp. Ballast case operating temperature shall not exceed 35°C temperature rise. The ballast shall be constant wattage electronic type with integrated control chip technology, constant wattage and constant light output with voltage fluctuations of ± 20% of nominal. Ballast shall operate at high frequency (over 20 KHZ) with a lamp current crest factor of 1.7 and a total harmonic distortion of less than 10%. The ballast shall be UL and CSA listed, high power factor, Class P, contain no PCB's and be made in the USA. Electronic circuit to meet FCC Part 18, Class A Requirements, and IEEE 587, Category A for transients. Ballast shall comply with Federal Ballast Legislation (Law 100-357) and be marked with E and have a full 3-year warranty.

B. Mercury vapor, metal halide, and high pressure sodium ballasts shall be manufactured with the following features:
   1. .125 minimum thickness extruded aluminum housing with heat dissipating fins.
   2. Die cast aluminum end cap closure.
   3. Thermally isolated capacitor enclosed in a diecast compartment with easy access for serviceability.
   4. Constant wattage, auto-stabilized, high power factor.
   5. All ballasts used indoors shall have core and coil encapsulated in a thermally conductive Class F (155 degree C), insulation material which isolates sound attenuating vibration.

C. Manufacturers: Advance, General Electric, Jefferson, Universal, Motorola and Magnetek as indicated on the drawings or approved equal for function specified. “Generic” ballasts that do not meet these specifications will be rejected.

2.5 FLUORESCENT FIXTURES

A. All fixtures, ballasts and supports shall be quiet in operation. Louvers, shields, reflectors and all sections of the channel structure shall be securely held in position. Fixtures shall not be mounted in such a way that ballast hum will be amplified or transmitted into work areas.

2.6 FINISH

A. Bonderized or equal treatment on all steel parts prior to applying finish. Metal parts shall have baked white enamel finish unless otherwise noted on the drawings.

2.7 FLUORESCENT LAMPHOLDERS

A. Designed so lamps will be held firmly in place, electrically and mechanically, permitting easy insertion or removal of lamps. Provide corrosion resistant silver plated lamp pin contacts.

2.8 CEILING TRIM

A. Furnish proper ceiling frames for the ceiling material in which recessed fixtures are to be installed. Verify prior to ordering. No extra allowance will be made for failure to furnish fixtures which are compatible with the ceiling system.
2.9 LENS
A. When an acrylic lens or diffuser is specified it shall be molded of 100% virgin acrylic meeting American Society for Testing Materials specifications for Methacrylate Molding and Extrusion Compounds (ASTM D788-63). Plastic diffusing panels, luminous side panels and other luminous plastic members of fixtures shall be made of not less than .125-inch-thick prismatic clear virgin acrylic material (similar and equal in pattern and construction to KSH K-12). The plastic shall be non-electrostatic or the finished parts shall be treated with an anti-static wax.

2.10 HOUSING
A. Not less than 22 gauge steel with baked white enamel finish applied over corrosion-resistant primer unless otherwise specifically approved.

PART 3 - EXECUTION

3.1 GENERAL
A. The Contractor shall furnish and install a lighting fixture, as hereinafter specified and scheduled, on each and every outlet in accordance with the type designation shown on the Drawings. If a type designation is omitted, the fixture shall be of the same type as is shown for rooms of similar usage. Verify before purchase and installation.

3.2 SUPPORTS
A. Support ceiling fixtures by anchorage to the ceiling only where the ceiling is concrete or masonry units. For ceilings of other construction, anchor ceiling fixtures to metal supports provided for that purpose, of suitable strength and stability, adequately attached to and supported by joists, trusses or other structural members, unless other methods of support are specifically approved by the Architect. Where lay-in construction is used, recessed fixtures shall be of the lay-in type. Earthquake clips will be used to secure all lay-in fixtures. The Contractor shall coordinate this work with all other trades involved. Coordinate supports for lay-in fixtures with ceiling Contractor.

3.3 LOW DENSITY CEILING
A. Special attention is directed to the code restrictions against mounting fixtures on combustible low density cellulose fiberboard (NEC 410-76). If fixtures are to be installed that are not UL approved for this condition, a suitable mounting arrangement shall be developed which meets the approval of the Architect/Engineer.

3.4 CEILING TRIM AND MEANS OF SUPPORT
A. The ceiling trim and means of support of recessed fixtures shall be coordinated with the type of ceiling to be installed to insure proper installation.

3.5 SUSPENDED FIXTURES
A. Provide swivel hangers to insure a plumb installation. For single unit suspended fluorescent fixtures provide tubings or stems for wiring at one point and a tubing or rod suspension provided for each unit of chassis. Provide 3/16 inch diameter rods minimum. All hangers and fittings to be of the same manufacture as the fixture.
3.6 LAMP GUARDS
   A. Provide safety guard clips or spring loaded lampholders on open type fluorescent fixtures to prevent lamps from falling.

3.7 CLEAN-UP
   A. At final inspection all fixtures and lighting equipment shall be in first class operating order, in perfect condition as to finish and free from defects, completely lamped, clean and free from dust, plaster or paint spots and complete with the required glassware, reflectors, side panels, louvers or other components necessary to complete the fixtures.

3.8 CEILING TRIM
   A. Furnish proper ceiling frames for the ceiling material in which recessed fixtures are to be installed, verify prior to ordering. Rims of all fixtures that overlap ceilings shall be installed tight and snug against the ceiling to prevent light leakage around the rim. If unevenness of surface allows light to show, then the Contractor shall provide soft sponge filler or gasket to correct the condition.

3.9 All recessed fixtures shall have top connections to the outlet boxes installed in accordance with the code. Connections to lay-in fixtures shall be made with flexible conduit 4'-0" minimum length.

3.10 The Contractor shall install new lamps in all lighting fixtures.

3.11 All ballasts shall be installed in a manner to assure a completely silent operation with maximum ballast life.

3.12 All lay-in fixtures shall be adequately supported by at least two ceiling support wires at opposite corners of fixture. If fire rating of the ceiling requires separate fixture support from the structure, such supports shall be installed.

3.13 All surface mounted fixtures shall be furnished with top plates whenever applicable.

3.14 All open reflector type fixtures shall be equipped with lamp safety guards to prevent lamp fallout.

END OF SECTION 265000
SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Excavating and filling for rough grading the Site.
   2. Preparing subgrades for slabs-on-grade, walks, and pavements.
   3. Excavating and backfilling for buildings and structures.
   4. Drainage course for concrete slabs-on-grade.
   5. Subbase course for concrete walks and pavements.
   7. Subsurface drainage backfill for walls and trenches.
   8. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
   2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping, and stockpiling, topsoil, and removal of above- and below-grade improvements and utilities.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices for earth moving specified in Section 012200 "Unit Prices."

B. Quantity allowances for earth moving are included in Section 012100 "Allowances."

C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.

   1. 24 inches (600 mm) outside of concrete forms other than at footings.
   2. 12 inches (300 mm) outside of concrete forms at footings.
   3. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
   4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
   5. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
6. 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions.
   2. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9 m) in length.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
   1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- (1065-mm-) maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,700 lbf (128 kN) and stick-crowd force of not less than 18,400 lbf (82 kN) with extra-long reach boom.
   2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp (172-kW) flywheel power and developing a minimum of 47,992-lbf (213.3-kN) breakout force with a general-purpose bare bucket.
I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. (0.57 cu. m) or more in volume that exceed a standard penetration resistance of 100 blows/2 inches (97 blows/50 mm) when tested by a geotechnical testing agency, according to ASTM D 1586.

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct preexcavation conference at Zia Pueblo.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
   a. Personnel and equipment needed to make progress and avoid delays.
   b. Coordination of Work with utility locator service.
   c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
   d. Extent of trenching by hand or with air spade.
   e. Field quality control

1.6 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

   1. Geotextiles.
   2. Controlled low-strength material, including design mixture.
   3. Geofoam.
   4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

   1. Geotextile: 12 by 12 inches (300 by 300 mm).
   2. Warning Tape: 12 inches (300 mm) long; of each color.
1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
   1. Classification according to ASTM D 2487.
   2. Laboratory compaction curve according to ASTM D 698 and ASTM D 1557.

C. Blasting plan approved by authorities having jurisdiction.

D. Seismic survey report from seismic survey agency.

E. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.8 QUALITY ASSURANCE

A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:
   1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
   2. Seismographic monitoring during blasting operations.

B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
   1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
   2. Seismographic monitoring during blasting operations.

C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.9 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

D. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

E. Do not direct vehicle or equipment exhaust towards protection zones.

F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

H. Drainage Course: 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 (37.5-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve.

I. 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 (25-mm) sieve and zero to 5 percent passing a No. 4 (4.75-mm) sieve.

J. Sand: ASTM C 33/C 33M; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.
PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.

   a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
3.4 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations 6 to 12 inches (150 to 300 mm) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches (300 mm) each side of pipe or conduit or as indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

3.7 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.8 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.9 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete" and Section 033053 "Miscellaneous Cast-in-Place Concrete."

D. Trenches under Roadways: Provide 4-inch- (100-mm-) thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of subbase material and satisfactory soil, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.
   a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches (300 mm) over the pipe or conduit. Coordinate backfilling with utilities testing.

G. Final Backfill:
   1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
   2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

H. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Walks: Plus or minus 1 inch (25 mm).
3. Pavements: Plus or minus 1/2 inch (13 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.14 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material classification and maximum lift thickness comply with requirements.
3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) or less of wall length but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length but no fewer than two tests.
F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.15 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.16 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
   1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Hot-mix asphalt patching.
   2. Hot-mix asphalt paving.

B. Related Requirements:
   1. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
   2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Zia Pueblo.
   1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
      a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
      b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include technical data and tested physical and performance properties.
   2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.
B. Material Certificates: For each paving material. Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.

C. Material Test Reports: For each paving material, by a qualified testing agency.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the New Mexico Department of Transportation.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the New Mexico Department of Transportation for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
4. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242/D 242M or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320, PG 64-22


C. Cutback Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-30 or MC-70 Consult state or local DOT for recommended asphalt-emulsion prime coat for local conditions.

D. Emulsified Asphalt Prime Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

E. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

F. Fog Seal: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

G. Water: Potable.


2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles, or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

C. Sand: ASTM D 1073 or AASHTO M 29, Grade No. 2 or No. 3.

D. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
E. Joint Sealant: ASTM D 6690 or AASHTO M 324, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

1. Surface Course Limit: Recycled content no more than 10 percent by weight.

B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: as indicated on Drawings.
3. Surface Course: as indicated on Drawings.

C. Emulsified-Asphalt Slurry: ASTM D 3910, Type 2.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.3 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.
   1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6 mm).
   1. Clean cracks and joints in existing hot-mix asphalt pavement.
   2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.
   3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
   1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m). Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth (0.5 to 1.40 L/sq. m per 25 mm depth). Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 250 deg F (121 deg C).
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches (25 to 38 mm) from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.
3.6 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

3.7 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927 or AASHTO T 245, but not less than 94 percent or greater than 100 percent.
2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 FIELD QUALITY CONTROL

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

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

   a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than three cores taken.

   b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

F. Replace and compact hot-mix asphalt where core tests were taken.

G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.9 WASTE HANDLING

A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION 321216