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PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 GEOTECHNICAL INVESTIGATION

A. Geotechnical Investigation Project No. ASA17-047-00 for the project site has been performed by RABA KISTNER, Inc, 12821 W Golden Lane, San Antonio, Texas 78249, PH. 210-699-9090, FAX. 210-699-6426, dated October 16, 2020, and is attached at the end of this section.

B. Log of borings indicates materials penetrated at specific locations. Owner and/or Architect assume no responsibility for any conclusions of interpretations made by Contractor related to information included in the Report. Should contractor require additional information concerning subsurface conditions, he may without cost to Owner, make additional investigations. Should additional investigations produce information different from that in Soil Report, promptly notify Owner in writing.

C. Contractor shall read and otherwise become completely familiar with contents of Soil Report, including but not limited to its recommendations for preparation of subsoil, bases, sub-bases and fill and construction of building foundations and parking surfaces in compliance with recommendations in Report. Should discrepancy be found between the requirements of Soil Report and the drawings and/or specifications, notify Owner in writing prior to beginning work.

1.03 EXISTING CONDITIONS

A. Bidders shall visit the site of work, existing buildings, review any available existing drawings, and all conditions affecting the work of this project. Any claims after contract award for difficulties encountered which could have been foreseen by such site review will not be recognized by the Owner.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 00 30 00
GEOTECHNICAL ENGINEERING STUDY

FOR

NEW VISITOR CHECK-IN BUILDING AND PARKING
DEVIL’S RIVER STATE NATURAL AREA
DEL RIO, TEXAS
Project No. ASA17-047-00
October 16, 2020

Ms. Janie Ramirez
Texas Parks & Wildlife
4200 Smith School Road
Austin, Texas 78744-3291

RE: Geotechnical Engineering Study
New Visitor Check-In Building and Parking
Devil’s River State Natural Area
Del Rio, Texas

Dear Ms. Ramirez:

RABA KISTNER, Inc. (RKI) is pleased to submit the report of our Geotechnical Engineering Study for the above-referenced project. This study was performed in general accordance with RKI Proposal No. PSA17-091-00 (Revised), dated July 28, 2017. The purpose of this study was to drill borings within the proposed site improvements, to perform laboratory testing to evaluate and characterize subsurface conditions, and to prepare an engineering report presenting foundation design and construction recommendations for the proposed site improvements, as well as to provide pavement design and construction guidelines.

The following report contains our design recommendations and considerations based on our current understanding of the information provided to us. There may be alternatives for value engineering of the foundation and pavement systems, and RKI recommends that a meeting be held with the Owner and design team to evaluate these alternatives.

We appreciate the opportunity to be of service to you on this project. Should you have any questions about the information presented in this report, or if we may be of additional assistance with value engineering or on the materials testing-quality control program during construction, please call.

Very truly yours,

RABA KISTNER, INC.

Eric J. Neuner, P.E.
Associate | Manager, San Antonio Engineering

IM/EJNI/kv

Attachments

Copies Submitted: Electronic (1)
GEOTECHNICAL ENGINEERING STUDY

For

NEW VISITOR CHECK-IN BUILDING AND PARKING
DEVIL’S RIVER STATE NATURAL AREA
DEL RIO, TEXAS

Prepared for

TEXAS PARKS & WILDLIFE
San Antonio, Texas

Prepared by

RABA KISTNER, INC.
San Antonio, Texas

PROJECT NO. ASA17-047-00

October 16, 2020
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INTRODUCTION

RABA KISTNER, Inc. (RKI) has completed the authorized subsurface exploration for the proposed improvements located at the Devil’s River State Natural Area near Del Rio, Texas, as illustrated on Figure 1. This report briefly describes the procedures utilized during this study and presents our findings along with our recommendations for foundation design and construction considerations, as well as for pavement design and construction guidelines.

PROJECT DESCRIPTION

The structures to be considered in this study include a new visitor check-in building, RV Parking area pavements, and a new septic system for the RV area. The improvements are located at the Devil’s River State Natural Area near Del Rio, Texas. Currently, the site is undeveloped and covered with low-lying vegetation and natural cobbles to boulders. The site generally slopes downward to the south and east. The Visitor Check-In building will be a single-story structure with a footprint of approximately 1,500 sq. ft. The proposed structures are anticipated to create relatively light structural loads to be carried by the foundation system. The improvements will also include ancillary driveway and parking area pavements. Retaining walls are not anticipated.

LIMITATIONS

This engineering report has been prepared in accordance with accepted Geotechnical Engineering practices in the region of south/central Texas and for the use of Texas Parks & Wildlife (CLIENT) and its representatives for design purposes. This report may not contain sufficient information for purposes of other parties or other uses. This report is not intended for use in determining construction means and methods. The attachments and report text should not be used separately.

The recommendations submitted in this report are based on the data obtained from 5 borings and surficial grab samples obtained at this site, our understanding of the project information provided to us, and the assumption that site grading will result in only minor changes in the existing topography. If the project information described in this report is incorrect, is altered, or if new information is available, we should be retained to review and modify our recommendations.

This report may not reflect the actual variations of the subsurface conditions across the site. The nature and extent of variations across the site may not become evident until construction commences. The construction process itself may also alter subsurface conditions. If variations appear evident at the time of construction, it may be necessary to reevaluate our recommendations after performing on-site observations and tests to establish the engineering impact of the variations.

The scope of our Geotechnical Engineering Study does not include an environmental assessment of the air, soil, rock, or water conditions either on or adjacent to the site. No environmental opinions are presented in this report.

If final grade elevations are significantly different from existing grades, our office should be informed about these changes. If needed and/or if desired, we will reexamine our analyses and make supplemental recommendations.
BORINGS AND LABORATORY TESTS

Subsurface conditions at the site were evaluated by 5 borings drilled at the locations shown on the Boring Location Map, Figure 1. These locations were measured using a Trimble GPS locator. The borings were drilled to depths ranging from 5 to 35 ft below the existing ground surface using a truck-mounted drilling rig. During drilling operations Split-Spoon samples (with Standard Penetration Tests) and auger grab samples were collected. In addition, due to site access issues, hand-auger grab samples of the surficial materials were obtained at locations not accessible to the truck-mounted drilling rig.

Each sample was visually classified in the laboratory by a member of our Geotechnical Engineering staff. The geotechnical engineering properties of the strata were evaluated by the moisture content, grain size analysis, and Atterberg Limit tests.

The laboratory test results are presented in graphical or numerical form on the boring logs illustrated on Figures 2 through 9. A key to classification terms and symbols used on the log is presented on Figure 10. The results of the laboratory and field testing are also tabulated on Figure 11 for ease of reference. Grain size distribution curves are presented on Figure 12.

Standard penetration test results are noted as “blows per ft” on the boring logs and Figure 11, where “blows per ft” refers to the number of blows by a falling hammer required for 1 ft of penetration into the soil/weak rock. Where hard or dense materials were encountered, the tests were terminated at 50 blows even if one foot of penetration had not been achieved. When all 50 blows fall within the first 6 in. (seating blows), refusal “ref” for 6 in. or less will be noted on the boring logs and on Figure 11.

Samples will be retained in our laboratory for 30 days after submittal of this report. Other arrangements may be provided at the request of the Client.

GENERAL SITE CONDITIONS

GEOLOGY

A review of the Geologic Atlas of Texas, Del Rio Sheet, indicates that this site is naturally underlain with the soils/rock of the Devils River Limestone and Salmon Peak Limestone Formations.

The Devils River Limestone formation consists of dolomite and limestone; hard. Locally dolomitized, brecciated, and chert bearing strata are more common in the upper part of the formation and nodular limestone in the basal part. The upper part may contain miliolid, rudistid mounds, shell fragments, and other marine fossils. Biosparite and lime mudstone are also common.

The Salmon Peak Limestone formation contains abundant mudstone, some crossbedded strata and large chert masses. White in color. There are abundant caprinids, globigerina, shell fragments and other marine fossils.
SEISMIC CONSIDERATIONS

The following information has been summarized for seismic considerations associated with this site per ASCE 7-16 edition.

- **Site Class Definition:** Class C. Based on the soil borings conducted for this investigation and our experience in the area, the upper 100 ft of soil may be characterized as very dense soil and soft rock.
- **Risk-Targeted Maximum Considered Earthquake Ground Motion Response Accelerations for the Conterminous United States of 0.2-Second Spectral Response Acceleration (5% Of Critical Damping):** $S_s = 0.055g$.
- **Risk-Targeted Maximum Considered Earthquake Ground Motion Response Accelerations for the Conterminous United States of 1-Second Spectral Response Acceleration (5% Of Critical Damping):** $S_1 = 0.024g$.
- **Values of Site Coefficient:** $F_a = 1.3$
- **Values of Site Coefficient:** $F_v = 1.5$
- Where $g$ is the acceleration due to gravity.

The Maximum Considered Earthquake Spectral Response Accelerations are as follows:

- 0.2 sec, adjusted: $S_{ms} = 0.071g$
- 1 sec, adjusted: $S_{m1} = 0.037g$

The Design Spectral Response Acceleration Parameters (SA) are as follows:

- 0.2 sec SA: $S_{DS} = 0.047g$
- 1 sec SA: $S_{D1} = 0.024g$

STRATIGRAPHY

In general, the natural subsurface stratigraphy at this site can be described as 1 ft or less of soil overburden consisting of clay, clayey gravel, or clayey sand, overlying tan limestone. We encountered limestone at a depth of approximately 2 ft at an alternate location near the existing road (Boring 2B). Each stratum has been designated by grouping materials that possess similar physical and engineering characteristics. The boring logs should be consulted for more specific stratigraphic information. Unless noted on the boring logs, the lines designating the changes between various strata represent approximate boundaries. The transition between materials may be gradual or may occur between recovered samples. The stratification given on the boring logs, or described herein, is for use by RKI in its analyses and should not be used as the basis of design or construction cost estimates without realizing that there can be variation from that shown or described.

The boring logs and related information depict subsurface conditions only at the specific locations and times where sampling was conducted. The passage of time may result in changes in conditions, interpreted to exist, at or between the locations where sampling was conducted.
GROUNDWATER

Groundwater was not observed in the borings either during or immediately upon completion of the drilling operations. The borings remained dry during the field exploration phase. However, it is possible for groundwater to exist beneath this site at shallow depths on a transient basis, particularly following periods of precipitation. Fluctuations in groundwater levels occur due to variation in rainfall and surface water run-off. The construction process itself may also cause variations in the groundwater level.

FOUNDATION RECOMMENDATIONS

Site grading plans were not available at the time of this study. On the basis of the limited information available at this time, site features that will influence the geotechnical approach to the proposed project include:

- Variable rock depth and the potential for weathered bedrock, and
- Presence of highly expansive surficial clays and potential for soil-related movements and mixed bearing conditions.

SITE GRADING

We have prepared our foundation recommendations based on the existing ground surface and the stratigraphic conditions encountered in our borings at the time of our study. RKI must be retained to review the site grading plans prior to bidding the project for construction. This will enable RKI to provide input for any changes in our original recommendations that may be required as a result of site grading operations or other considerations.

EXPANSIVE SOIL-RELATED MOVEMENTS

The depth of the soil overburden within the proposed building footprint was generally less than 1 ft below the existing ground surface in our borings, which in turn is underlain by limestone bedrock. The surficial clays and clayey materials contribute solely to the Potential Vertical Rise (PVR) values estimated for this site. The anticipated ground movements due to swelling of the underlying soils at the site were estimated for slab-on-grade construction using the empirical procedure, Texas Department of Transportation (TxDOT) Tex-124-E, Method for Determining the PVR. A PVR value of 1 in. or less was estimated for the stratigraphic conditions encountered in our borings and is based on the existing ground surface elevations. A surcharge load of 1 psi (concrete slab and sand layer), a soil active zone to the top of limestone, and dry moisture conditions were assumed in estimating the above PVR values.

To reduce the risk for potential soil related movements, we recommend to completely remove the expansive materials to the top of rock. With this consideration, we recommend that all of the clays and clayey soils be completely removed from within and 3 ft around the proposed building area and the overexcavation backfilled with compacted select fill.
The overexcavated soils may be reused on site, and beyond the building pad, provided that the potential vertical movements in excess of those discussed previously will not adversely impact either the structural or operational tolerances for the proposed improvements for which this material is being considered.

The TxDOT method of estimating expansive soil-related movements is based on empirical correlations utilizing the measured plasticity indices and assuming typical seasonal fluctuations in moisture content. If desired, other methods of estimating expansive soil-related movements are available, such as estimations based on swell tests and/or soil-suction analyses. However, the performance of these tests and the detailed analysis of expansive soil-related movements were beyond the scope of the current study. It should also be noted that actual movements can exceed the calculated PVR values due to isolated changes in moisture content (such as due to leaks, landscape watering....) or if water seeps into the soils to greater depths than the assumed active zone depth due to deep trenching or excavations.

Drainage Considerations

At this site, considerations of surface and subsurface drainage may be crucial to construction and adequate foundation performance of the soil-supported structures. Filling an excavation in relatively impervious plastic clays, if any, with relatively pervious select fill material creates a “bathtub” beneath the structure, which can result in ponding or trapped water within the fill unless good surface and subsurface drainage is provided.

Water entering the fill surface during construction or entering the fill exposed beyond the building lines after construction may create problems with fill moisture control during compaction and increased access for moisture to the underlying expansive clays, if any, both during and after construction.

Several surface and subsurface drainage design features and construction precautions can be used to limit problems associated with fill moisture. These features and precautions may include but are not limited to the following:

- Installing berms or swales on the uphill side of the construction area to divert surface runoff away from the excavation/fill area during construction;
- Sloping of the top of the subgrade with a minimum downward slope of 1.5 percent out to the base of a dewatering trench located beyond the building perimeter;
- Sloping the surface of the fill during construction to promote runoff of rain water to drainage features until the final lift is placed;
- Sloping of a final, well maintained, impervious clay or pavement surface (downward away from the building) over the select fill material and any perimeter drain extending beyond the building lines, with a minimum gradient of 6 in. in 5 ft;
- Constructing final surface drainage patterns to prevent ponding and limit surface water infiltration at and around the building perimeter;
- Locating the water-bearing utilities, roof drainage outlets and irrigation spray heads outside of the select fill and perimeter drain boundaries; and
- Raising the elevation of the ground level floor slab.
Details relative to the extent and implementation of these considerations must be evaluated on a project-specific basis by all members of the project design team. Many variables that influence fill drainage considerations may depend on factors that are not fully developed in the early stages of design. For this reason, drainage of the fill should be given consideration at the earliest possible stages of the project.

**SHALLOW FOUNDATIONS**

The proposed structure may be founded on shallow foundations or a stiffened engineered beam and slab foundation, provided the selected foundation type can be designed to withstand the anticipated soil-related movements (see *Expansive Soil-Related Movements*) without impairing either the structural or the operational performance of the structure. On the basis of the surficial expansive soils at this site, it is a viable option (and is recommended) to completely remove the expansive soils and replace with compacted select fill to reduce the potential for differential soil-related movements.

It is possible that bedrock may occur as pinnacles, higher or lower bedrock elevations, than those encountered in our borings. Depending on the site grading plan, foundation depth and the top of bedrock, boulders, pinnacles, ledge rock (stringers), or clayed filled solution features may be encountered near or at the required bearing stratum. In the case of a shallow foundation system, there is a potential for some of the footings bearing on soil/fill and others bearing on bedrock. We do not recommend that the foundations be founded partially in bedrock and partially in natural soils or select fill as this condition may result in greater differential movements. In this instance, we recommend that all foundations be extended down to bear on bedrock.

Considerable variation in the bearing elevation and quantity of rock excavation should be anticipated. *Appropriate contingency fees should be allocated for removal of weathered bedrock and extending foundations through weathered bedrock to competent rock.*

**Allowable Bearing Capacity**

Shallow foundations founded on soil/fill or bedrock may be proportioned using the design parameters tabulated below.

<table>
<thead>
<tr>
<th>Shallow Foundation Design Parameters</th>
<th>18 in.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum depth below final grade</td>
<td>18 in.*</td>
</tr>
<tr>
<td>Minimum beam or strip footing width</td>
<td>12 in.</td>
</tr>
<tr>
<td>Minimum widened beam or spread footing width</td>
<td>18 in.</td>
</tr>
<tr>
<td>Maximum allowable bearing pressure for foundations on natural soil or compacted fill</td>
<td>2,500 psf**</td>
</tr>
<tr>
<td>Maximum allowable bearing pressure for foundations on intact bedrock</td>
<td>4,000 psf**</td>
</tr>
</tbody>
</table>

* If bedrock is encountered within the minimum depth below final grade, penetrations of 4 in. into the rock can be considered. However, the minimum beam depths should be discussed with the structural engineer.

** We do not recommend that the foundations for an individual structure be founded partially in bedrock and partially in natural soils or compacted fill as this condition may result in greater differential movements. If mixed bearing conditions are encountered, we recommended that the foundations either be extended down into the bedrock, or if constructed on a select fill building pad, that a minimum of 6 in. of select fill be placed and compacted beneath the foundations.
The above presented maximum allowable bearing pressures will provide a factor of safety of about 3, provided that fill is placed as discussed herein and the subgrade is prepared in accordance with the recommendations outlined in the Site Preparation section of this report.

Spread foundations should bear on relatively competent rock, which may underlie a few feet of weathered rock. The foundations should be excavated through the weathered rock to more competent rock. Excavation into the bedrock will require hard rock excavating techniques. The bottom of the excavation should generally be level; however, it is permissible to excavate vertical steps if required to expose sound bedrock. Loose material should be removed from the foundation excavations. Overexcavations may be backfilled with lean concrete or flowable fill.

The prepared subgrade should be observed by a registered professional engineer knowledgeable in geotechnical engineering, or their representative to evaluate that the bearing surface is capable of supporting the design bearing pressures.

Isolated Structures

Isolated structures may be supported on shallow foundations bearing on compacted select fill or natural material, provided the selected foundation type can be designed to withstand the anticipated soil-related movements without impairing either the structural or the operational performance of the structure. The specific amount of overexcavation required will depend on the magnitude of movement that can be tolerated. Footings may be proportioned using the allowable bearing pressures presented herein. The size and depth of footings can be adjusted as necessary to resist wind loads. If the potential soil-related movements are excessive for the proposed structures, or if wind loads are greater than what the shallow foundations can resist, then deeper and oversized footings or deep foundations may be considered. For isolated structures we recommend extending foundations to similar bearing material to reduce differential movements.

Uplift Resistance

Resistance to vertical force (uplift) is provided by the weight of the concrete footing plus the weight of the soil directly above the footing. For this site, it is recommended that the ultimate uplift resistance be based on total unit weights for soil and concrete of 125 pcf and 150 pcf, respectively. The calculated ultimate uplift resistance should be reduced by a factor of safety of 1.2 to calculate the allowable uplift resistance.

Lateral Resistance

Horizontal loads acting on shallow foundations will be resisted by passive earth pressure acting on one side of the footing and by base adhesion for footings in soil or bedrock. Resistance to sliding for foundations bearing on natural/compacted soil or bedrock may be calculated utilizing an ultimate coefficient of friction of 0.35 or 0.70, respectively. The lateral resistance for these foundations should be limited to 875 psf (soil) or 2,800 psf (bedrock). An equivalent fluid pressure of 250 pcf (soil) or 350 pcf (bedrock) may be utilized to determine the ultimate passive resistance, if required.
FLOOR SLABS

Floor slabs within the superstructure may be ground supported provided the anticipated movements discussed under the Expansive Soil-Related Movements section of this report will not impair the performance of the floor, frame, or roof systems.

If differential movements between the slab and the structure are objectionable, soil-supported floor slabs could be dowelled to the perimeter grade beams. Dowelled slabs that are subjected to heaving will typically crack and develop a plastic hinge along a line which will be approximately 5 to 10 ft inside and parallel to the grade beams. Slabs cast independent of the grade beams, interior columns and partitions should experience minimum cracking, but may create difficulties at critical entry points such as doors and may impact interior partitions that are secured to exterior walls.

We recommend that a vapor barrier comprised of polyethylene or polyvinyl chloride (PVC) sheeting be placed between the supporting select fill and the concrete floor slab.

AREA FLATWORK

It should be noted that ground-supported flatwork such as walkways, courtyards, etc. will be subject to the same magnitude of potential soil-related movements as discussed previously (see Expansive Soil-Related Movement section). Thus, where these types of elements abut rigid building foundations or isolated/suspended structures, differential movements should be anticipated. As a minimum, we recommend that flexible joints be provided where such elements abut the main structure to allow for differential movement at these locations. Where the potential for differential movement is objectionable, it may be beneficial to consider methods of reducing anticipated movements.

FOUNDATION CONSTRUCTION CONSIDERATIONS

SITE DRAINAGE

Drainage is an important key to the successful performance of any foundation. Good surface drainage should be established prior to and maintained after construction to help prevent water from ponding within or adjacent to the building foundation and to facilitate rapid drainage away from the building foundation. Failure to provide positive drainage away from the structure can result in localized differential vertical movements in soil supported foundations and floor slabs (which can in turn result in cracking in the sheetrock partition walls, and shifting of ceiling tiles, as well as improper operation of windows and doors).

Current ordinances, in compliance with the Americans with Disabilities Act (ADA), may dictate maximum slopes for walks and drives around and into new buildings. These slope requirements can result in drainage problems for buildings supported on expansive soils. We recommend that, on all sides of the building, the maximum permissible slope be provided away from the building.

Also to help control drainage in the vicinity of the structure, we recommend that roof/gutter downspouts and landscaping irrigation systems not be located adjacent to the building foundation. Where a select fill overbuild is provided outside of the floor slab/foundation footprint, if any, the surface should be sealed.
with an impermeable layer (pavement or clay cap) to reduce infiltration of both irrigation and surface waters. Careful consideration should also be given to the location of water bearing utilities, as well as to provisions for drainage in the event of leaks in water bearing utilities. All leaks should be immediately repaired.

Other drainage and subsurface drainage issues are discussed in the *Expansive Soil-Related Movements* section of this report and under *Pavement Construction Considerations*.

**SITE PREPARATION**

Building areas and all areas to support select fill should be stripped of all vegetation and organic topsoil. Furthermore, as discussed in a previous section of this report, if a ground-supported floor system is chosen for the proposed structure, we recommend that the surficial soils be removed from the building footprint to reduce soil-related movements and eliminate mixed bearing conditions.

Exposed subgrades should be thoroughly proofrolled in order to locate weak, compressible zones. A fully-loaded dump truck or a similar heavily-loaded piece of construction equipment should be used for planning purposes. Proofrolling operations should be observed by the Geotechnical Engineer or their representative to document subgrade condition and preparation. Weak or soft areas identified during proofrolling should be removed and replaced with suitable, compacted engineered fill, free of organics, oversized materials, and degradable or deleterious materials.

In areas where clays remain after stripping (i.e. beyond the building pad) the exposed subgrade should be moisture conditioned. This should be done after completion of the proofrolling operations and just prior to fill placement. Moisture conditioning is done by scarifying to a minimum depth of 6 in. and recompacting to a minimum of 95 percent of the maximum density determined from TxDOT, Tex-114-E or ASTM D698, Compaction Test. The moisture content of the subgrade should be maintained within the range of optimum moisture content to 3 percentage points above optimum moisture content until permanently covered. This consideration may be waived, if the subgrade consists of bedrock.

**ONSITE SOIL**

The use of onsite soils may be considered for general fill (outside of the building pad), if the potential vertical movements in excess of those discussed previously will not adversely impact either the structural or operational tolerances for the proposed improvements for which this material is being considered.

**ONSITE ROCK FILL**

If excavations extend into the limestone formation, consideration can be given to utilizing the excavated material for select fill. However, processing of the excavated material will be required to reduce the maximum particle size to 4 in. Furthermore, special care will be required during excavation activities to separate organics and any plastic clay seams encountered. In addition, the processed material must meet the specifications given above for select fill materials. If onsite materials cannot be processed to meet the required criteria, imported select fill materials should be utilized.
SELECT FILL

Materials used as select fill for final site grading preferably should be crushed stone or gravel aggregate. Recommendations for select fill materials are provided below.

**Imported Crushed Limestone Base** – Imported crushed limestone base materials should be crushed stone or gravel aggregate. We recommend that materials specified for use as select fill meet the TxDOT 2014 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, Item 247, Flexible Base, Types A through E, Grades 1-2, 3, or 5.

**Granular Pit Run Materials** – Granular pit run materials should consist of GC, SC & combination soils (clayey gravels), as classified according to the Unified Soil Classification System (USCS). Alternative select fill materials shall have a maximum liquid limit not exceeding 40, a plasticity index between 7 and 20, and a maximum particle size not exceeding 4 inch. In addition, if these materials are utilized, grain size analyses and Atterberg Limits must be performed during placement at a rate of one test each per 5,000 cubic yards of material due to the high degree of variability associated with pit-run materials.

**Low PI Materials** – Low PI materials should consist of CL clays, as classified according to the Unified Soil Classification System (USCS). Alternative select fill materials shall have a maximum liquid limit not exceeding 40, a plasticity index between 7 and 20, and a maximum particle size not exceeding 4 inch. In addition, if these materials are utilized, grain size analyses and Atterberg Limits must be performed during placement at a rate of one test each per 5,000 cubic yards of material due to the high degree of variability associated with these materials.

If the above listed materials are being considered for bidding purposes, the materials should be submitted to the Geotechnical Engineer for pre-approval at a minimum of 10 working days or more prior to the bid date. Failure to do so will be the responsibility of the contractor. The contractor will also be responsible for ensuring that the properties of all delivered alternate select fill materials are similar to those of the pre-approved submittal. It should also be noted that when using alternative fill materials such as Granular Pit Run or Low PI Materials, difficulties may be experienced with respect to moisture control during and subsequent to fill placement, as well as with erosion, particularly when exposed to inclement weather. This may result in sloughing of beam trenches and/or pumping of the fill materials.

Granular Pit Run or Low PI Materials will be very susceptible to small changes in moisture content and to disturbance from foot traffic during the placement of steel reinforcement in beam trenches, particularly in periods of inclement weather. Disturbance from such foot traffic and from the accumulation of excess water can result in losses in bearing capacity and increased settlement. If inclement weather is anticipated at the time construction, consideration should be given to protecting the bottom of foundation excavations by placing a thin mud mat (layer of flowable fill or lean concrete) at the bottom of trenches immediately following excavation. This will reduce disturbance from foot traffic and will impede the infiltration of surface water. The side slopes of beam trench excavations may also need to be flattened to reduce sloughing in cohesionless soils. All necessary precautions should be implemented to protect open excavations from the accumulation of surface water runoff and rain.
Soils classified as CH, MH, ML, SM, GM, OH, OL and Pt under the USCS are not considered suitable for use as select fill materials at this site.

**Select Fill Placement and Compaction** Select fill should be placed in loose lifts not exceeding 8 in. in thickness and compacted to at least 95 percent of maximum density as determined by TxDOT, Tex-113-E, Compaction Test, or 98 percent of maximum density as determined by ASTM D698. The moisture content of the fill should be maintained within the range of 2 percentage points below to 2 percentage points above the optimum moisture content until final compaction for imported crushed limestone base.

**General Fill Placement and Compaction** The remaining fill (such as parking lot areas or green spaces) may be compacted to at least 95 percent of maximum density as determined by TxDOT, Tex-114-E, Compaction Test, or ASTM D698. The moisture content of the fill should be maintained within the range of optimum to plus 3 percentage points above the optimum moisture content until final compaction.

**SHALLOW FOUNDATION EXCAVATIONS**

Shallow foundation excavations should be observed by the Geotechnical Engineer or their representative prior to placement of reinforcing steel and concrete. This is necessary to evaluate that the bearing material at the bottom of the excavations is similar to those encountered in our borings and that excessive loose materials, mixed bearing conditions, and water are not present in the excavations. If soft soils are encountered in the foundation excavations, they should be removed and replaced with lean concrete, or flowable fill up to the design foundation bearing elevations.

**EXCAVATION SLOPING AND BENCHING**

If utility trenches or other excavations extend to or below a depth of 5 ft below construction grade, the contractor or others shall be required to develop a trench safety plan to protect personnel entering the trench or trench vicinity. The collection of specific geotechnical data and the development of such a plan, which could include designs for sloping and benching or various types of temporary shoring, are beyond the scope of the current study. Any such designs and safety plans shall be developed in accordance with current OSHA guidelines and other applicable industry standards.

**EXCAVATION EQUIPMENT**

Please note that limestone bedrock was encountered in our borings at depths ranging from approximately 4 in. to 2 ft below the existing ground surface. Excavations into this material will require hard rock excavation techniques and may be difficult to remove in narrow trenches or footing excavations. Our boring logs are not intended for use in determining construction means and methods and may therefore be misleading if used for that purpose. We recommend that earth-work and utility contractors interested in bidding on the work perform their own tests in the form of test pits to determine the quantities of the different materials to be excavated, as well as the preferred excavation methods and equipment for this site.
UTILITIES

Utilities which project through slab-on-grade, slab-on-fill, or any other rigid unit should be designed with either some degree of flexibility or with sleeves. Such design features will help reduce the risk of damage to the utility lines as vertical movements occur.

Our experience indicates that significant settlement of backfill can occur in utility trenches, particularly when trenches are deep, when backfill materials are placed in thick lifts with insufficient compaction, and when water can access and infiltrate the trench backfill materials. The potential for water to access the backfill is increased where water can infiltrate flexible base materials due to insufficient penetration of curbs, and at sites where geological features can influence water migration into utility trenches (such as fractures within a rock mass or at contacts between rock and clay formations). It is our belief that another factor which can significantly impact settlement is the migration of fines within the backfill into the open voids in the underlying free-draining bedding material.

To reduce the potential for settlement in utility trenches, we recommend that consideration be given to the following:

- All backfill materials should be placed and compacted in controlled lifts appropriate for the type of backfill and the type of compaction equipment being utilized and all backfilling procedures should be tested and documented.
- Curbs should completely penetrate base materials and be installed to a sufficient depth to reduce water infiltration beneath the curbs into the pavement base materials.
- Consideration should be given to wrapping free-draining bedding gravels with a geotextile fabric (similar to Mirafi 140N) to reduce the infiltration and loss of fines from backfill material into the interstitial voids in bedding materials.

RETAINING STRUCTURES

Below grade walls may be required at the site. The following sections provide general information for evaluating lateral earth pressures, backfill compaction, drainage, and the footings for the walls, if needed.

Lateral Earth Pressures

Equivalent fluid density values for computation of lateral soil pressures acting on walls were evaluated for various types of backfill materials that may be placed behind the walls. These values, as well as corresponding lateral earth pressure coefficients and estimated unit weights, are presented in the following.
The values tabulated above under “Active Conditions” pertain to flexible retaining walls free to tilt outward as a result of lateral earth pressures. For rigid, non-yielding walls the values under “At-Rest Conditions” should be used. The at-rest condition is present when the wall is not allowed to move. Once the wall moves outward a short distance, it relieves part of the horizontal stress. The horizontal movement required to reach the active condition, for the onsite soils, may be estimated by using 0.01*H (where H is the wall height). For example, for a 10 ft. tall wall, horizontal movements up to 1.2 inches may be required to develop the active condition. Once the soil attains the active condition, the horizontal stress in the soil (and thus the pressure acting on the wall) will be reduced.

Flatwork, structures, or other grade supported features directly behind the wall may experience settlements similar to the horizontal movements. Where these types of movements are objectionable, the retaining wall should be designed using At-Rest Conditions. For the provided values to be valid for sand or gravel backfill, the backfill should be placed in a wedge extending upward and away from the edge of the wall at a 45-degree angle or flatter. If sand and gravel are to be placed within a steeper wedge, the values for Pit Run Gravels/Sands, or Inorganic Clays provided above should be used. Further, any soft soil on the excavation slope should be removed prior to placement of backfill.

The values presented above assume the surface of the backfill materials to be level. Sloping the surface of the backfill materials will increase the surcharge load acting on the structures. The above values also do not include the effect of surcharge loads such as loading from foundations, construction equipment, vehicular loads, or future storage near the structures. Nor do the values account for possible hydrostatic pressures resulting from groundwater seepage entering and ponding within the backfill materials. However, these surcharge loads and groundwater pressures should be considered in designing any structures subjected to lateral earth pressures.

The onsite surficial clays exhibit significant shrink/swell characteristics. The use of clay soils as backfill against the any retaining structures is not recommended. Clays generally provide higher design active earthen pressures, as indicated above, but may also exert additional active pressures associated with
swelling. Controlling the moisture and density of these materials during placement will help reduce the likelihood and magnitude of future active pressures due to swelling, but this is no guarantee.

**Backfill Compaction**

Placement and compaction of backfill behind the walls will be critical, particularly at locations where backfill will support adjacent near-grade foundations, floor slabs, and/or flatwork. If the backfill is not properly compacted in these areas, the adjacent foundations, floor slabs, or flatwork can be subject to settlement.

To reduce potential settlement of adjacent foundations/flatwork, the backfill materials should be placed and compacted as recommended in the Select Fill section of this report. Each lift or layer of the backfill should be tested during the backfilling operations to document the degree of compaction. Within at least a 5 ft. zone of the wall backside, we recommend that compaction be accomplished by using thinner fill lifts and using hand-guided compaction equipment capable of achieving the maximum density in a series of 3 to 5 passes.

**Drainage**

The use of drainage systems is a positive design step toward reducing the possibility of hydrostatic pressure acting against the retaining structures. Drainage may be provided by the use of a drain trench and pipe. The drain pipe should consist of a slotted, heavy duty, corrugated polyethylene pipe and should be installed and bedded according to the manufacturer’s recommendations. The drain trench should be filled with gravel (meeting the requirements of ASTM D 448 coarse concrete aggregate Size No. 57 or 67) and extend from the base of the structure to within 2 ft of the top of the structure. The bottom of the drain trench will provide an envelope of gravel around the pipe with minimum dimensions consistent with the pipe manufacturer’s recommendations. The gravel should be wrapped with a suitable geotextile fabric (such as Mirafi 140N or equivalent) to help minimize the intrusion of fine-grained soil particles into the drain system. The pipe should be sloped and equipped with clean-out access fittings consistent with state-of-the-practice plumbing procedures.

As an alternative to a full-height gravel drain trench behind the proposed retaining structures, consideration may be given to utilizing a manufactured geosynthetic material for wall drainage. A number of products are available to control hydrostatic pressures acting on earth retaining structures, including Amerdrain (manufactured by American Wick Drain Corp.), Miradrain (manufactured by Mirafi, Inc.), Enkadrain (manufactured by American Enka Company), and Geotech Insulated Drainage Panel (manufactured by Geotech Systems Corp.). The geosynthetics are placed directly against the retaining structures and are hydraulically connected to the gravel envelope located at the base of the structures.

Weepholes may be provided along the length of the proposed retaining structures, if desired, in addition to one of the two alternative drainage measures presented above. Based on our experience, weepholes, as the only drainage measure, often become clogged with time and do not provide the required level of drainage from behind retaining structures. We recommend that RKI review the final retaining structure drainage design before construction.
Retaining Wall Footings

Footings may be designed using the parameters provided in the section titled Shallow Foundations. There is a potential that the retaining walls may partially bear on soil and others on rock. Where the soil/rock transitions occur, there is an increased potential for differential settlement. To reduce the potential for differential settlement at these transitions, we recommend extending the retaining wall foundations down to similar bearing material.

PERMANENT SLOPES

The stability of permanent slopes depends on many factors, including the height and geometry of the slopes, the types of soils contained in the slopes, effects of groundwater, and any surface pressures present. In general, permanent cut and fill slopes, constructed at 1V:3H (1 vertical on 3 horizontal) have been observed to perform satisfactorily. Therefore, it is our opinion that slopes should be constructed at 1V:3H or flatter. Fill slopes should be constructed by extending the compacted fill beyond the planned profile of the slope and then trimming the slope to the desired configuration. Cut slopes can be designed similar to fill slopes. However, the potential for sloughing and/or general slope failure increases with an increase in the steepness and depth of cut, particularly if low strength soil or rock occurs in or near the base of the slope.

PAVEMENT RECOMMENDATIONS

Recommendations for both flexible (including asphalt and flexible base only) and rigid pavements are presented in this report. The Owner and/or design team may select either pavement type depending on the performance criteria established for the project. In general, flexible pavement systems have a lower initial construction cost as compared to rigid pavements. However, maintenance requirements over the life of the pavement are typically much greater for flexible pavements. This typically requires regularly scheduled observation and repair, as well as overlays and/or other pavement rehabilitation at approximately one-half to two-thirds of the design life. Rigid pavements are generally more “forgiving”, and therefore tend to be more durable and require less maintenance after construction.

For either pavement type, drainage conditions will have a significant impact on long term performance, particularly where permeable base materials are utilized in the pavement section. Drainage considerations are discussed in more detail in a subsequent section of this report.

SUBGRADE CONDITIONS

We have assumed the subgrade in pavement areas will consist of the recompacted onsite soils placed and compacted as recommended in the Onsite Soils (Pavements) section of this report, or milled limestone. Based on our experience with similar subgrade soils and SPT results, we have assigned a California Bearing Ratio (CBR) value of 3.0 for soil subgrade and 7.0 for limestone subgrade for use in pavement thickness design analyses.

If site grading exposes limestone subgrade in pavement areas, the pavement section can be reduced as presented in the Flexible Pavement section of this report. This reduction is based on our experience with similar rock subgrades.
DESIGN INFORMATION

The following recommendations were prepared using design criteria presented in the American Association of State Highway and Transportation Officials (AASHTO) 1993 edition of the AASHTO “Guide for the Design of Pavement Structures. The following recommendations were prepared assuming a 20-yr design life and Equivalent Single Axle Loads (ESAL’s) of 15,000 for light duty pavements and 50,000 for heavy duty pavements. This traffic frequency is approximately equivalent to 1 and 3 tractor-trailer trucks per day for a design period of 20 years for light and heavy duty pavements, respectively. The Project Civil Engineer should review anticipated traffic loading and frequencies to verify that the assumed traffic loading and frequency is appropriate for the intended use of the facility.

FLEXIBLE PAVEMENT (ASPHALT)

Flexible pavement sections recommended for this site are as listed in the following tables for the applicable subgrade materials:

<table>
<thead>
<tr>
<th>Soil Subgrade</th>
<th>Flexible Pavement Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Type</td>
<td>Flexible Base (in.)</td>
</tr>
<tr>
<td>Light Duty Traffic (parking areas)</td>
<td>8</td>
</tr>
<tr>
<td>Heavy Duty Traffic (entrances, driveways, and channelized)</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rock Subgrade</th>
<th>Flexible Pavement Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Type</td>
<td>Flexible Base (in.)</td>
</tr>
<tr>
<td>Light or Heavy Duty Traffic</td>
<td>6</td>
</tr>
</tbody>
</table>

Based on our experience, the reported sections often perform adequately; however, maintenance or an overlay is generally needed sooner than would be required for a thicker design section. Consideration could be given to adding additional asphalt (i.e. an additional 1 in.), incorporating a geogrid below the flexible base for the soil subgrade pavement section.

Another option to help reduce the potential for cracking and maintenance in asphalt pavements is including reinforcing fibers, such as Forta-Fi®, into the Hot Mix Asphalt (HMA). These are options and are not required. The geogrid reinforcement should conform to TxDOT Type 2 geogrid, or an approved substitute. If geogrid or reinforcing fibers are used in the provided options, we do not recommend reducing the report sections without further discussion with the design team. Geogrid may also be considered at the rock/clay transition zones to reduce hinging caused by differential movement between the soils and rock subgrade. If considered, the geogrid should extend approximately 10 ft into the transitioned material.
Garbage Dumpsters

We recommend that reinforced concrete pads be provided in front of and beneath trash receptacles. Concrete pads at this site should be a minimum of 6 in. thick. The dumpster trucks should be parked on the rigid pavement when the receptacles are lifted.

It is suggested that such pads also be provided in drives where the dumpster trucks make turns with small radii to access the receptacles. The concrete pads at this site should be a minimum of 6 in. thick and reinforced with conventional steel reinforcing bars or welded wire mats.

FLEXIBLE BASE ONLY SECTIONS

We have provided options for a flexible base only roadway section. Removing the Hot Mix Asphalt (HMA) layer and leaving the same flex base thickness will shorten the section design life. Also, due to the lack of a relatively impermeable surface, flexible base only sections will be susceptible to weather and environmental conditions. However, without the HMA in place, this makes repairs/re-grading relatively easier. The Project Civil Engineer should review anticipated traffic loading and frequencies to verify that the assumed traffic loading and frequency is appropriate for the intended use of the facility and pavement section. Options for flexible base only sections for this site are listed in the table below:

<table>
<thead>
<tr>
<th>Option</th>
<th>Flexible Base Thickness (in.)</th>
<th>Lifetime ESAL's</th>
<th>Estimated Traffic Coefficient (Flexible ESAL's per vehicle pass)</th>
<th>Estimated Number of Lifetime Truck Passes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6</td>
<td>300</td>
<td>2.4</td>
<td>125</td>
</tr>
<tr>
<td>B</td>
<td>6**</td>
<td>680</td>
<td>2.4</td>
<td>283</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
<td>1,050</td>
<td>2.4</td>
<td>437</td>
</tr>
<tr>
<td>D</td>
<td>12</td>
<td>9,300</td>
<td>2.4</td>
<td>3,875</td>
</tr>
<tr>
<td>E</td>
<td>12**</td>
<td>29,000</td>
<td>2.4</td>
<td>12,083</td>
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</tbody>
</table>

*Other alternatives are available and can be provided upon request.
**Mechanically stabilized layer (Geogrid below the base section). The geogrid reinforcement should be similar to TxDOT Type 2 Geogrid, Tensar TX 5 or an approved substitute.
Summary of Flexible Base Only Pavement Sections for Rock Subgrade

<table>
<thead>
<tr>
<th>Option</th>
<th>Flexible Base Thickness (in.)</th>
<th>Lifetime ESAL’s</th>
<th>Estimated Traffic Coefficient (Flexible ESAL’s per vehicle pass)</th>
<th>Estimated Number of Lifetime Truck Passes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6</td>
<td>2,000</td>
<td>2.4</td>
<td>833</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>7,400</td>
<td>2.4</td>
<td>3,083</td>
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<tr>
<td>C</td>
<td>12</td>
<td>66,000</td>
<td>2.4</td>
<td>27,500</td>
</tr>
</tbody>
</table>

*Other alternatives are available and can be provided upon request.

RIGID PAVEMENT

We recommend that rigid pavements be considered in areas of channelized traffic, particularly in areas where truck or bus traffic is planned, and particularly where such traffic will make frequent turns, such as described above for garbage dumpster areas. We recommend that rigid pavement sections at this site consist of the following:

<table>
<thead>
<tr>
<th>Traffic Type</th>
<th>Portland Cement Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Duty Traffic</td>
<td>5 in.</td>
</tr>
<tr>
<td>Heavy Duty Traffic</td>
<td>6 in.</td>
</tr>
</tbody>
</table>

Rigid Pavement Consideration

We recommend Jointed Plain Concrete Pavement (JPCP) be utilized for the rigid pavement sections. JPCP typically does not require distributed steel, micro- or macro-fibers, or any other “reinforcing” material. The following recommendations are based on ACI 330R-08 “Guide for the Design and Construction of Concrete Parking Lots.”

Typical joint types in JPCP include: control (contraction) joints, isolation joints (sometimes called expansion joints), and construction joints. The recommended joint spacing is 30 times the thickness of the slab up to a maximum of 15 ft. The length of a slab or panel should not be more than 25% greater than its width. For pavements with a thickness of 7 in. or greater, if any, dowels may be required along all control joints. Tie bars may be required at the first longitudinal joint from the pavement edge to keep the outside slabs from separating from the pavement.

Isolation joints are used to separate concrete slabs from other structures or fixed objects within or abutting the paved area to offset the effects of expected differential horizontal and vertical movements. Such structures include, but are not limited to, buildings, light standard foundations, and drop inlets. Isolation joints are also used at “T” intersections to accommodate differential movement along the different axes. Isolations joints are sometimes referred to as expansion joints. However, they are rarely needed to accommodate concrete expansion so they are not typically recommended for use as regularly spaced joints.
We recommend a jointing layout plan be established and reviewed by all parties prior to construction. We also recommend avoiding jointing lines which create angles of less than 60 degrees, “T” joints, and interior corners.

Proper curing of the concrete pavement should be initiated immediately after finishing. All control joints should be formed or sawed to a depth of at least 1/4 the thickness of the concrete slab and should extend completely through monolithic curbs (if used). Sawing of control joints should begin as soon as the concrete will not ravel, preferably within 1 to 3 hours using an early entry saw or 4 to 8 hours with a conventional saw. Timing will be dictated by site conditions.

**FIRE LANE**

Based on available literature, a 75,000 pound fire truck will impart approximately 6.9 ESALs per pass. Therefore, the proposed pavement sections provided herein will be able to support occasional fire truck traffic.

**PAVEMENT CONSTRUCTION CONSIDERATIONS**

**SUBGRADE PREPARATION**

Areas to support pavements should be stripped of all vegetation and organic topsoil and the exposed subgrade should be proofrolled in accordance with the recommendations in the Site Preparation section under Foundation Construction Considerations.

In areas where clay is encountered, after completion of the proofrolling operations and just prior to flexible base placement, the exposed subgrade should be moisture conditioned by scarifying to a minimum depth of 6 in. and recompacted to at least 95 percent of maximum density as determined by TxDOT, Tex-114-E, Compaction Test, or ASTM D698. The moisture content of the subgrade should be maintained within the range of optimum moisture content to 3 percentage points above optimum until permanently covered.

**ONSITE SOILS (PAVEMENTS)**

As discussed previously, the pavement recommendations presented in this report were prepared assuming that on-site soils will be used for fill grading in proposed pavement areas. If used, we recommend that on-site soils be placed in loose lifts not exceeding 8 in. in thickness and be compacted to at least 95 percent of maximum density as determined by TxDOT, Tex-114-E, Compaction Test, or ASTM D698. The moisture content of the fill should be maintained within the range of optimum water content to 3 percentage points above the optimum water content until permanently covered. We recommend that fill materials be free of roots and other organic or degradable material. We also recommend that the maximum particle size not exceed 4 in. or one half the lift thickness, whichever is smaller.
DRAINAGE CONSIDERATIONS

As with any soil-supported structure, the satisfactory performance of a pavement system is contingent on the provision of adequate surface and subsurface drainage. Insufficient drainage which allows saturation of the pavement subgrade and/or the supporting granular pavement materials will greatly reduce the performance and service life of the pavement systems.

Surface and subsurface drainage considerations crucial to the performance of pavements at this site include (but are not limited to) the following:

1) Any known natural or man-made subsurface seepage at the site which may occur at sufficiently shallow depths as to influence moisture contents within the subgrade should be intercepted by drainage ditches or below grade French drains.

2) Final site grading should eliminate isolated depressions adjacent to curbs, if any, which may allow surface water to pond and infiltrate into the underlying soils. Curbs should completely penetrate base materials and should be installed to sufficient depth to reduce infiltration of water beneath the curbs.

3) Pavement surfaces should be maintained to help minimize surface ponding and to provide rapid sealing of any developing cracks. These measures will help reduce infiltration of surface water downward through the pavement section.

FLEXIBLE BASE COURSE

The flexible base course should be crushed limestone conforming to TxDOT 2014 Standard Specifications, Item 247, Types A through E, Grades 1-2, 3, or 5. Base course should be placed in lifts with a maximum thickness of 8 in. and compacted to a minimum of 95 percent of the maximum density at a moisture content within the range of 2 percentage points below to 2 percentage points above the optimum moisture content as determined by Tex-113-E, or 98 percent of maximum density as determined by ASTM D698.

ASPHALTIC CONCRETE SURFACE COURSE

The asphaltic concrete surface course should conform to TxDOT Standard Specifications, Item 340, Type C or D. The asphaltic concrete should be compacted to a minimum of 92 percent of the maximum theoretical specific gravity (Rice) of the mixture determined according to Test Method Tex-227-F. Pavement specimens, which shall be either cores or sections of asphaltic pavement, will be tested according to Test Method Tex-207-F. The nuclear-density gauge or other methods which correlate satisfactorily with results obtained from project roadway specimens may be used when approved by the Engineer. Unless otherwise shown on the plans, the Contractor shall be responsible for obtaining the required roadway specimens at their expense and in a manner and at locations selected by the Engineer.

PORTLAND CEMENT CONCRETE

The Portland cement concrete should have a minimum 28-day compressive strength of 4,000 psi. A liquid membrane-forming curing compound should be applied as soon as practical after finishing the concrete.
surface. The curing compound will help reduce the loss of water from the concrete. The reduction in the rapid loss in water will help reduce shrinkage cracking of the concrete.

**MISCELLANEOUS PAVEMENT RELATED CONSIDERATIONS**

**Longitudinal Cracking**

It should be understood that asphalt pavement sections in expansive soil environments, can develop longitudinal cracking along unprotected pavement edges. This condition typically occurs along the unprotected edges of pavements where moisture fluctuation is allowed to occur over the lifetime of the pavements.

Pavements that do not have a protective barrier to reduce moisture fluctuation of the expansive clay subgrade between the exposed pavement edge and that beneath the pavement section tend to develop longitudinal cracks 1 to 4 ft from the edge of the pavement. Once these cracks develop, further degradation and weakening of the underlying granular base may occur due to water seepage through the cracks. The occurrence of these cracks can be more prevalent in the absence of lateral restraint and embankments. This problem can best be addressed by providing either a horizontal or vertical moisture barrier at the unprotected pavement edge.

At a minimum, we recommend that the curbs are constructed such that the depth of the curb extends through the entire depth of the granular base material and into the subgrade to act as a protective barrier against the infiltration of water into the granular base.

In most cases, a longitudinal crack does not immediately compromise the structural integrity of the pavement system. However, if left unattended, infiltration of surface water runoff into the crack will result in isolated saturation of the underlying base. This will result in pumping of the flexible base, which could lead to rutting, cracking, and pot-holes. For this reason, we recommend that the owner of the facility immediately seal the cracks and develop a periodic sealing program.

**Pavement Maintenance**

Regular pavement maintenance is critical in maintaining pavement performance over a period of several years. All cracks that develop in asphalt pavements should be regularly sealed. Areas of moderate to severe fatigue cracking (also known as alligator cracking) should be sawcut and removed. The underlying base should be checked for contamination or loss of support and any insufficiencies fixed or removed and the entire area patched.

All cracks that develop in concrete pavements should be routed and sealed regularly. Joints in concrete pavements should be maintained to reduce the influx of incompressible materials that restrain joint movement and cause spalling and/or cracking. Other typical facility maintenance techniques should be followed as required.
Construction Traffic

Construction traffic on prepared subgrade or granular base should be restricted as much as possible until the protective asphalt surface pavement is applied. Significant damage to the underlying layers resulting in weakening may occur if heavily loaded vehicles are allowed to use these areas prior to the complete construction of the pavement section. Heavy traffic loads should not be allowed on light duty traffic areas either before or after completion of the pavement section.

CONSTRUCTION RELATED SERVICES

CONSTRUCTION MATERIALS TESTING AND OBSERVATION SERVICES

As presented in the attachment to this report, Important Information About Your Geotechnical Engineering Report, subsurface conditions can vary across a project site. The conditions described in this report are based on interpolations derived from a limited number of data points. Variations will be encountered during construction, and only the geotechnical design engineer will be able to determine if these conditions are different than those assumed for design.

Construction problems resulting from variations or anomalies in subsurface conditions are among the most prevalent on construction projects and often lead to delays, changes, cost overruns, and disputes. These variations and anomalies can best be addressed if the geotechnical engineer of record, RKI is retained to perform construction observation and testing services during the construction of the project. This is because:

- RKI has an intimate understanding of the geotechnical engineering report’s findings and recommendations. RKI understands how the report should be interpreted and can provide such interpretations on site, on the client’s behalf.
- RKI knows what subsurface conditions are anticipated at the site.
- RKI is familiar with the goals of the owner and project design professionals, having worked with them in the development of the geotechnical workscope. This enables RKI to suggest remedial measures (when needed) which help meet the owner’s and the design teams’ requirements.
- RKI has a vested interest in client satisfaction, and thus assigns qualified personnel whose principal concern is client satisfaction. This concern is exhibited by the manner in which contractors’ work is tested, evaluated and reported, and in selection of alternative approaches when such may become necessary.
- RKI cannot be held accountable for problems which result due to misinterpretation of our findings or recommendations when we are not on hand to provide the interpretation which is required.

BUDGETING FOR CONSTRUCTION TESTING

Appropriate budgets need to be developed for the required construction testing and observation activities. At the appropriate time before construction, we advise that RKI and the project designers meet and jointly develop the testing budgets, as well as review the testing specifications as it pertains to this project.
Once the construction testing budget and scope of work are finalized, we encourage a preconstruction meeting with the selected contractor to review the scope of work to make sure it is consistent with the construction means and methods proposed by the contractor. RKI looks forward to the opportunity to provide continued support on this project, and would welcome the opportunity to meet with the Project Team to develop both a scope and budget for these services.
ATTACHMENTS
BORING LOCATION MAP
NEW VISITOR CHECK-IN BUILDING AND PARKING
DEVIL'S RIVER STATE NATURAL AREA
DEL RIO, TEXAS

SOURCE: Aerial photograph obtained from City of San Antonio - 2013

PROJECT No.: ASA17-047-00
ISSUE DATE: 07/08/2020
DRAWN BY: KR
CHECKED BY: IM
REVIEWED BY: EJN

FIGURE 1

NOTE: This Drawing is Provided for Illustration Only, May Not be to Scale and is Not Suitable for Design or Construction Purposes
CLAY, Dark Brown, with sand
Sampling terminated due to refusal (bedrock). The drill rig was not able to access the location.

### LOG OF BORING NO. B-1

New Visitor Check-In Building and Parking
Devil’s River State Natural Area
Del Rio, Texas

<table>
<thead>
<tr>
<th>DEPTH, FT</th>
<th>SYMBOL</th>
<th>SAMPLES</th>
<th>DESCRIPTION OF MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td></td>
<td></td>
<td>CLAY, Dark Brown, with sand</td>
</tr>
</tbody>
</table>

Sampling terminated due to refusal (bedrock). The drill rig was not able to access the location.

### LOCATION:
N 29.72997; W 100.96101

### NOTE:
These logs should not be used separately from the project report.
CLAY, Dark Brown, with sand
Boring terminated due to refusal (bedrock). The drilling location was offset due to accessibility issues. See Boring 2B.
### LOG OF BORING NO. B-2B

**New Visitor Check-In Building and Parking**  
Devil's River State Natural Area  
Del Rio, Texas

**Drilling Method:** Straight Flight Auger & Air Rotary  
**Location:** N 29.73027; W 100.96177

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Symbol</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>5</td>
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<td></td>
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<tr>
<td>99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Description of Material**
- SAND, Clayey, Dense, Tan, with gravel and calcareous deposits
- LIMESTONE, Hard, Tan

**Drills per Ft**
- 37

**Unit Dry Weight (pcf)**
- N 29.7  30.2  27.7  100.9

**Plasticity Index**
- 47  30

**Shear Strength, Tons/ft²**
- 2

**Notes:** These logs should not be used separately from the project report.
**LOG OF BORING NO. B-3**  
New Visitor Check-In Building and Parking  
Devil’s River State Natural Area  
Del Rio, Texas

**DRILLING METHOD:** Straight Flight Auger & Air Rotary  
**LOCATION:** N 29.72987; W 100.96122

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION OF MATERIAL</th>
<th>BLOWS PER FT</th>
<th>UNIT DRY WEIGHT,pcf</th>
<th>PLASTICITY INDEX</th>
<th>SHEAR STRENGTH, TONS/FT²</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>GRAVEL, Clayey, Very Dense, Dark Brown, with sand</td>
<td>50/3.5”</td>
<td>29.7</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>35</td>
<td>LIMESTONE, Hard, Tan</td>
<td>ref/1”</td>
<td>29.8</td>
<td>1.0</td>
<td>20</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>ref/1”</td>
<td>71.1</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>ref/1”</td>
<td>100.9</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>ref/1”</td>
<td>29.8</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>ref/1”</td>
<td>29.8</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>ref/1”</td>
<td>29.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>ref/1”</td>
<td>29.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Boring Terminated</td>
<td>ref/1”</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DEPTH DRILLED:** 33.6 ft  
**DATE DRILLED:** 6/25/2020  
**DEPTH TO WATER:** Dry  
**DATE MEASURED:** 6/25/2020  
**PROJ. No.:** ASA17-047-00  
**FIGURE:** 5
**LOG OF BORING NO. P-1**

New Visitor Check-In Building and Parking
Devil's River State Natural Area
Del Rio, Texas

**DRILLING METHOD:** Straight Flight Auger & Air Rotary

**LOCATION:** N 29.73066; W 100.96159

---

**DESCRIPTION OF MATERIAL**

- 50/4" ref/1"
- **CLAY, Sandy, Hard, Tan, calcareous, with gravel and calcareous deposits**
- **LIMESTONE, Hard, Tan**

**Boring Terminated**

---

**SHEAR STRENGTH, TONS/FT**

<table>
<thead>
<tr>
<th>Unit Dry Weight, psf</th>
<th>BLOWS PER FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>70</td>
<td>80</td>
</tr>
</tbody>
</table>

**PLASTICITY INDEX**

- % -200

**NOTE:** THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

---

**DEPTH DRILLED:** 3.6 ft
**DATE DRILLED:** 6/25/2020
**DEPTH TO WATER:** Dry
**DATE MEASURED:** 6/25/2020
**PROJ. No.:** ASA17-047-00
**FIGURE:** 6
### LOG OF BORING NO. P-2
New Visitor Check-In Building and Parking
Devil’s River State Natural Area
Del Rio, Texas

**DRILLING METHOD:** Straight Flight Auger & Air Rotary

**LOCATION:** N 29.72968; W 100.96174

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SAMPLES</th>
<th>DESCRIPTION OF MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>GRAVEL, Clayey, Dark Brown, with sand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LIMESTONE, Hard, Tan</td>
</tr>
</tbody>
</table>

**Boring Terminated**

**DEPTH TO WATER:** Dry

**DEPTH DRILLED:** 3.6 ft

**DATE DRILLED:** 6/25/2020

**DATE MEASURED:** 6/25/2020

**PROJ. No.:** ASA17-047-00

**FIGURE:** 7
**LOG OF BORING NO. S-1**

New Visitor Check-In Building and Parking
Devil's River State Natural Area
Del Rio, Texas

**LOCATION:**
N 29.73647; W 100.96002

**DRILLING METHOD:** Straight Flight Auger & Air Rotary

<table>
<thead>
<tr>
<th>DEPTH, FT</th>
<th>SYMBOL</th>
<th>SAMPLES</th>
<th>DESCRIPTION OF MATERIAL</th>
<th>BLOWS PER FT</th>
<th>UNIT DRY WEIGHT, pcf</th>
<th>PLASTICITY INDEX</th>
<th>% -200</th>
<th>SHEAR STRENGTH, TONS/FT²</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.7 ft</td>
<td>50/7&quot;</td>
<td></td>
<td>CLAY, Stiff to Hard, Dark Brown, with sand</td>
<td>50/7&quot;</td>
<td>80</td>
<td>46</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>50/8&quot;</td>
<td></td>
<td>LIMESTONE, Hard, Tan</td>
<td>50/8&quot;</td>
<td>80</td>
<td>53</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>50/8&quot;</td>
<td></td>
<td>CLAY, Sandy, Hard, Tan, with calcareous deposits</td>
<td>50/8&quot;</td>
<td>80</td>
<td>53</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>50/8&quot;</td>
<td></td>
<td>LIMESTONE, Hard, Tan</td>
<td>50/8&quot;</td>
<td>80</td>
<td>53</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>50/8&quot;</td>
<td></td>
<td>Boring Terminated</td>
<td>50/8&quot;</td>
<td>80</td>
<td>53</td>
<td>80</td>
<td></td>
</tr>
</tbody>
</table>

**DEPTH DRILLED:** 4.7 ft
**DATE DRILLED:** 6/25/2020
**DEPTH TO WATER:** Dry
**DATE MEASURED:** 6/25/2020
**PROJ. No.:** ASA17-047-00
**FIGURE:** 8

- **NOTE:** These logs should not be used separately from the project report.

- **PROJ. No.:** ASA17-047-00

- **FIGURE:** 8
**LOG OF BORING NO. S-2**
New Visitor Check-In Building and Parking  
Devil's River State Natural Area  
Del Rio, Texas

**DRILLING METHOD:** Hand Sample  

<table>
<thead>
<tr>
<th>DEPTH, FT</th>
<th>SYMBOL</th>
<th>SAMPLES</th>
<th>DESCRIPTION OF MATERIAL</th>
<th>BLOWS PER FT</th>
<th>UNIT DRY WEIGHT, pcf</th>
<th>PLASTICITY INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>GRAVEL</td>
<td>Clayey</td>
<td>Dark Brown</td>
<td>1</td>
<td>29.7</td>
<td>46</td>
</tr>
</tbody>
</table>

Sampling terminated due to refusal (bedrock). The drill rig was not able to access the location.

**LOCATION:** N 29.73036; W 100.96086

**DEPTH DRILLED:** 0.5 ft  
**DATE DRILLED:** 6/25/2020  
**DEPTH TO WATER:** Dry  
**DATE MEASURED:** 6/25/2020  
**PROJ. No.:** ASA17-047-00  
**FIGURE:** 9

**NOTE:** THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT
## Key to Terms and Symbols

### Material Types

<table>
<thead>
<tr>
<th>Soil Terms</th>
<th>Rock Terms</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcareous</td>
<td>Chalk</td>
<td>Asphalt</td>
</tr>
<tr>
<td>Caliche</td>
<td>Claystone</td>
<td>Base</td>
</tr>
<tr>
<td>Clay</td>
<td>Clay-shale</td>
<td>Concretion/Concrete</td>
</tr>
<tr>
<td>Clayey</td>
<td>Conglomerate</td>
<td>Bricks/Pavers</td>
</tr>
<tr>
<td>Gravel</td>
<td>Dolomite</td>
<td>Waste</td>
</tr>
<tr>
<td>Gravelly</td>
<td>Shale</td>
<td>No Information</td>
</tr>
<tr>
<td>Fill</td>
<td>Silite</td>
<td>No Information</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Recovery</td>
</tr>
</tbody>
</table>

### Well Construction and Plugging Materials

<table>
<thead>
<tr>
<th>Blank Pipe</th>
<th>Bentonite</th>
<th>Bentonite &amp; Cuttings</th>
<th>Cuttings</th>
<th>Volclay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen</td>
<td>Cement Grout</td>
<td>Concrete/Cement</td>
<td>Gravel</td>
<td></td>
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</tr>
</tbody>
</table>

### Sample Types

<table>
<thead>
<tr>
<th>Air Rotary</th>
<th>Mud Rotary</th>
<th>N. X. Core</th>
<th>Geoprobe Sampler</th>
<th>Rotosonic Damaged</th>
<th>Rotosonic Intact</th>
<th>Pitcher</th>
<th>Texas Cone Penetrometer</th>
<th>Shelby Tube</th>
<th>Split Barrell</th>
<th>Split Spoon</th>
<th>Pocket Penetrometer</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

### Strength Test Types

- Pocket Penetrometer
- Torvane
- Unconfined Compression
- Triaxial Compression Unconsolidated-Undrained
- Triaxial Compression Consolidated-Undrained

Note: Values symbolized on boring logs represent shear strengths unless otherwise noted.

---

**Figure 10a**

**Project No. ASA17-047-00**

**Revised 04/2012**
KEY TO TERMS AND SYMBOLS (CONT’D)

TERMINOLOGY

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOILS MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in American Society for Testing and Materials D2487-06 and D2488-00, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 2005.

The depths shown on the boring logs are not exact, and have been estimated to the nearest half-foot. Depth measurements may be presented in a manner that implies greater precision in depth measurement, i.e. 6.71 meters. The reader should understand and interpret this information only within the stated half-foot tolerance on depth measurements.

<table>
<thead>
<tr>
<th>Penetration Resistance Blows per ft</th>
<th>Relative Density</th>
<th>Resistance Blows per ft</th>
<th>Consistency</th>
<th>Cohesion TSF</th>
<th>Plasticity Index</th>
<th>Degree of Plasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4</td>
<td>Very Loose</td>
<td>0 - 2</td>
<td>Very Soft</td>
<td>0 - 0.125</td>
<td>0 - 5</td>
<td>None</td>
</tr>
<tr>
<td>4 - 10</td>
<td>Loose</td>
<td>2 - 4</td>
<td>Soft</td>
<td>0.125 - 0.25</td>
<td>5 - 10</td>
<td>Low</td>
</tr>
<tr>
<td>10 - 30</td>
<td>Medium Dense</td>
<td>4 - 8</td>
<td>Firm</td>
<td>0.25 - 0.5</td>
<td>10 - 20</td>
<td>Moderate</td>
</tr>
<tr>
<td>30 - 50</td>
<td>Dense</td>
<td>8 - 15</td>
<td>Stiff</td>
<td>0.5 - 1.0</td>
<td>20 - 40</td>
<td>Plastic</td>
</tr>
<tr>
<td>&gt; 50</td>
<td>Very Dense</td>
<td>15 - 30</td>
<td>Very Stiff</td>
<td>1.0 - 2.0</td>
<td>&gt; 40</td>
<td>Highly Plastic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 30</td>
<td>Hard</td>
<td>&gt; 2.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ABBREVIATIONS

- B = Benzene
- T = Toluene
- E = Ethylbenzene
- X = Total Xylenes
- BTEX = Total BTEX
- TPH = Total Petroleum Hydrocarbons
- ND = Not Detected
- NA = Not Analyzed
- NR = Not Recorded/No Recovery
- OVA = Organic Vapor Analyzer
- ppm = Parts Per Million
- Qam, Qas, Qal = Quaternary Alluvium
- Qat = Low Terrace Deposits
- Qbc = Beaumont Formation
- Qt = Fluvial Terrace Deposits
- Q-Tu = Uvalde Gravel
- Ewi = Wilcox Formation
- Emi = Midway Group
- Mc = Catahoula Formation
- EI = Laredo Formation
- Knm = Navarro Group and Marlbrook Marl
- Kpg = Pecan Gap Chalk
- Kau = Austin Chalk

Key to abbreviations:

- Kef = Eagle Ford Shale
- Kbu = Buda Limestone
- Kdr = Del Rio Clay
- Kft = Fort Terrett Member
- Kgt = Georgetown Formation
- Kep = Person Formation
- Kek = Kainer Formation
- Kes = Escondido Formation
- Kew = Walnut Formation
- Kgr = Glen Rose Formation
- Kgru = Upper Glen Rose Formation
- Kgrl = Lower Glen Rose Formation
- Kh = Hensell Sand
KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

SOIL STRUCTURE

Slickensided    Having planes of weakness that appear slick and glossy.
Fissured        Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket          Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting          Inclusion less than 1/8 inch thick extending through the sample.
Seam            Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer            Inclusion greater than 3 inches thick extending through the sample.
Laminated        Soil sample composed of alternating partings or seams of different soil type.
Interlayered     Soil sample composed of alternating layers of different soil type.
Intermixed       Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous       Having appreciable quantities of carbonate.
Carbonate        Having more than 50% carbonate content.

SAMPLING METHODS

RELATIVELY UNDISTURBED SAMPLING

Cohesive soil samples are to be collected using three-inch thin-walled tubes in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587) and granular soil samples are to be collected using two-inch split-barrel samplers in general accordance with the Standard Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM D1586). Cohesive soil samples may be extruded on-site when appropriate handling and storage techniques maintain sample integrity and moisture content.

STANDARD PENETRATION TEST (SPT)

A 2-in.-OD, 1-3/8-in.-ID split spoon sampler is driven 1.5 ft into undisturbed soil with a 140-pound hammer free falling 30 in. After the sampler is seated 6 in. into undisturbed soil, the number of blows required to drive the sampler the last 12 in. is the Standard Penetration Resistance or "N" value, which is recorded as blows per foot as described below.

SPLIT-BARREL SAMPLER DRIVING RECORD

<table>
<thead>
<tr>
<th>Blows Per Foot</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>25 blows drove sampler 12 inches, after initial 6 inches of seating.</td>
</tr>
<tr>
<td>50/7&quot;</td>
<td>50 blows drove sampler 7 inches, after initial 6 inches of seating.</td>
</tr>
<tr>
<td>Ref/3&quot;</td>
<td>50 blows drove sampler 3 inches during initial 6-inch seating interval</td>
</tr>
</tbody>
</table>

NOTE: To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.
## RESULTS OF SOIL SAMPLE ANALYSES

**PROJECT NAME:** New Visitor Check-In Building and Parking  
Devil's River State Natural Area  
Del Rio, Texas

**FILE NAME:** ASA17-047-00.GPJ  
7/13/2020

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Sample Depth (ft)</th>
<th>Blows per ft</th>
<th>Water Content (%)</th>
<th>Liquid Limit</th>
<th>Plastic Limit</th>
<th>Plasticity Index</th>
<th>USCS</th>
<th>Dry Unit Weight (pcf)</th>
<th>% -200 Sieve</th>
<th>Shear Strength (lbf)</th>
<th>Strength Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>0.0 to 0.5</td>
<td>9</td>
<td>58</td>
<td>30</td>
<td>28</td>
<td>CH</td>
<td></td>
<td></td>
<td>81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-2A</td>
<td>0.0 to 0.4</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-2B</td>
<td>0.0 to 1.5</td>
<td>37</td>
<td>8</td>
<td>80</td>
<td>33</td>
<td>47</td>
<td>SC</td>
<td></td>
<td>30</td>
<td></td>
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<td>CL</td>
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**Legend:**  
PP = Pocket Penetrometer  
TV = Torvane  
UC = Unconfined Compression  
FV = Field Vane  
UU = Unconsolidated Undrained Triaxial  
CU = Consolidated Undrained Triaxial  
CH = Clayey-Humus  
SC = Silt-Coupled  
CL = Clay-Limy
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Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared solely for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client’s goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

• not prepared for you;
• not prepared for your project;
• not prepared for the specific site explored; or
• completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

• the function of the proposed structure, as when it’s changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
• the elevation, configuration, location, orientation, or weight of the proposed structure;
• the composition of the design team; or
• project ownership.

As a general rule, always inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. Do not rely on a geotechnical-engineering report whose adequacy may have been affected by: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. Contact the geotechnical engineer before applying this report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report’s Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. Confirmation-dependent recommendations are not final, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report’s confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations’ applicability.

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members’ misinterpretation of geotechnical-engineering reports has resulted in costly
problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team’s plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer’s Logs
Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

Give Constructors a Complete Report and Guidance
Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, but preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report’s accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. Be sure constructors have sufficient time to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely
Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered
The equipment, techniques, and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated environmental problems have led to numerous project failures. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. Do not rely on an environmental report prepared for someone else.

Obtain Professional Assistance To Deal with Mold
Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the express purpose of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; none of the services performed in connection with the geotechnical engineer’s study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance
Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.
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<td>Mexico</td>
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SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section includes administrative and procedural requirements for unit prices.
B. Related Requirements:
   1. Division 01 Section - Contract Modification Procedures for procedures for submitting and handling Change Orders.
   2. Division 01 Section - Quality Requirements for general testing and inspecting requirements.

1.03 DEFINITIONS
A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.04 PROCEDURES
A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
D. Contractor shall be responsible for any changes in the Work affected by acceptance of alternates. Claims for additional costs or time extensions resulting from changes to the Work as a result of the Owner’s election of any or all Alternates will not be allowed.
E. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS
Not Used.

PART 3 - EXECUTION

3.01 SCHEDULE OF UNIT PRICES
A. Unit Price No. 1: Provide unit prices for adding electrical power boxes
   Description: If additional electrical power is determined to be required, provide a unit price for adding additional electrical outlet boxes per each as noted below. Price assumes walls are not
closed up and accessible for installation of conduit and boxes from at least one side; and does not include any finishes repair that may be required.

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<tr>
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<td>Not Applicable</td>
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<tr>
<td>A2. Add power outlet on nearby power circuit</td>
<td>$_____/each</td>
<td>Not Applicable</td>
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<tr>
<td>A3. Add dedicated power with home run to panel, on spare breaker.</td>
<td>$_____/each</td>
<td>Not Applicable</td>
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B. Unit Price No. 2: Provide Unit Price for Adding Data Drops Boxes.
   1. Description: add data drops boxes with ¾” or 1” conduit in wall as required to above accessible ceiling, in the event that additional data is determined to be required. Price assumes walls are not closed up and accessible for installation of conduit and boxes from at least one side; and does not include any finishes repair that may be required. Include cabling back to MDF and dual data termination / face plate, or similar.

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<th>DEDUCT</th>
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<tr>
<td>B1. Add data drop</td>
<td>$_____/each</td>
<td>Not Applicable</td>
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END OF SECTION 01 22 00
SECTION 03 10 00 - CONCRETE FORMWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Bidding Requirements, Contract Forms, Conditions of the Contract and Division 1 - General Requirements apply to the work of this section.

1.02 DESCRIPTION OF WORK

A. Furnish all labor, materials, tools, equipment and related items required to install formwork and shoring for cast-in-place concrete, and installation into formwork of items furnished by others, such as anchor bolts, setting plates, bearing plates, anchorages, inserts, frames, nosings and other items to be embedded in concrete.

B. Related work specified in other sections:
   1. Concrete Paving - Section 32 13 13
   2. Concrete Reinforcement - Section 03 20 00
   3. Cast-in-Place Concrete - Section 03 30 00
   4. Polished Concrete Floor Finishing – Section 03 35 36

1.03 QUALITY ASSURANCE

A. It is Contractor's responsibility to design and engineer formwork.

B. Reference Standards:
   1. ACI 301, Specifications for Structural Concrete for Buildings.

C. Allowable Tolerances: Except when close coordination and fitting of various trades' work precludes allowance of tolerance, maximum total permissible deviations from established lines, grades and dimensions shall be as stated below. See and maintain forms in such manner as to ensure completed work within specified tolerance limits.
   1. Variation from plumb:
      a. In lines and surfaces of arises:
         In any 10 ft of length ...................... 1/4 in.
         Maximum for the entire length .......... 1 in.
      b. For exposed conspicuous lines:
         In any 20 ft of length ...................... 1/4 in.
         Maximum for the entire length .......... 1/2 in.
   2. Variation in sizes and location of sleeves, floor, and wall openings .......... +/-1/4 in.
   3. Variation in cross-sectional dimensions of beams in thickness of slabs:
      Minus ......................................... 1/4 in.
D. Max. deflection of form facing materials at concrete surfaces exposed to view shall be 1/240 of span between structural members.

1.04 Shop Drawings

A. Shop Drawings: Diagram of proposed construction joints not indicated on drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Forms: Wood, metal or other approved material that will not adversely affect surface of concrete and will provide or facilitate obtaining specified surface finish.

1. Wood:
   a. Unexposed Surfaces:
      1. No.2 Common or Better Southern Yellow Pine lumber, sufficient thickness to sustain loads to be imposed, dressed to uniform smooth contact surfaces, readily removable, or:
      2. Commercial Standard Douglas-Fir, moisture resistant, concrete form plywood, not less than 5 ply, at least 3/4" thick, one side smooth.
   b. Exposed Surfaces: Non-absortive overlay plywood such as medium or high-density overlay, Finn-Form or equal.

B. Carton Forms: Rectangular configuration, Surevoid, Container Corporation of America, "Voidco" or equal, double wall, laminated using water resistant adhesive and coated with paraffin containing 10% polyethylene, sizes as indicated.

C. Form Accessories:
   1. Form ties: Bolt rods or patented devices having a minimum tensile strength of 3,000 pounds when fully assembled. Ties shall be adjustable in length and free of lugs, cones, washers, or other features which would leave a hole larger than 1" in diameter. Ties shall be of such construction that, when forms are removed, there will be no metal remaining within 1" of finished surface.
   2. Form Release Agent: Non-Staining, wax barrier type, Symons Corp., "Magic Cote" or equal.
   3. Construction Joint Form: Burke Concrete Products "Keyed Kold Joint" or equal.

PART 3 - EXECUTION

3.01 PERFORMANCE

A. Formwork Construction:
1. Construct forms tight to prevent loss of mortar. Use chamfer strips in corners of forms to produce beveled edges on permanently exposed surfaces.
2. Camber formwork to compensate for deflections in formwork prior to concrete attaining design strength.
3. Adjust shores and struts to take up settlement caused by concrete placement.
4. Provide temporary openings in formwork to allow cleaning and observation.
5. Construct forms for beams and girders so that sides may be removed without disturbing bottom of form or its support.
6. Clean contact and screed surfaces of hardened concrete and foreign materials prior to assembly.

B. Form Coatings:
1. Apply specified form release agent; follow manufacturer's direction.
2. Do not allow agent to puddle in forms or to contact hardened concrete against which fresh concrete is to be placed.
3. Do not coat forms with material that will stain or disfigure exposed concrete surfaces; do not use forms coated with such material.

C. Form Accessories:
1. Form Ties: Coat ties that are to be pulled from walls with cup grease or other approved material to facilitate removal.

D. Construction Joints:
1. Locate and install construction joints, which are not shown on the drawings, so as not to impair strength and appearance of the structure, and as acceptable to the Structural Engineer.
2. Provide keyways at least 1-1/2" deep in construction joints in walls and slabs; accepted bulkheads designed for this purpose may be used for slabs.
3. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.
4. Construct isolation joints in slabs on ground at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated.

E. Installation of Embedded Items:
1. Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

END OF SECTION 03 10 00
SECTION 03 20 00 - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Bidding Requirements, Contract Forms, Conditions of the Contract and Division 1 - General Requirements apply to the work of this section.

1.02 DESCRIPTION OF WORK

A. Furnish all labor, materials, tools, equipment, and related items required to fabricate and place reinforcement for cast-in-place concrete, including bars, welded wire fabric, ties and bar supports.

B. Related work specified in other sections:
   1. Testing Laboratory Services - Section 01 40 00
   2. Portland Cement Concrete Paving - Section 32 13 13
   3. Concrete Formwork - Section 03 10 00
   4. Cast-in-Place Concrete - Section 03 30 00.

1.03 QUALITY ASSURANCE

A. Reference Standards:
   1. ACI 301, Specifications for Structural Concrete
   2. ACI 318, Building Code Requirements for Structural Concrete
   3. ASTM A615, Specification for Deformed Carbon Steel Bars for Concrete.
   4. ASTM A1064, Specifications for Welded Steel Wire Fabric for Concrete Reinforcement.
   5. Concrete Reinforcing Steel Institute, Manual of Standard Practice.
   7. CRSI 63 – Recommended Practice for Placing Reinforcing Bars.
   8. CRSI 63 – Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.

B. Allowable Tolerances:
   1. Fabricating:
      a. Sheared length: Plus or minus 1 inch
      b. Stirrups and ties: Plus or minus ½ inch.
      c. Members more than 8 inch but not over 2'-0" deep: Plus or minus 1/2 inch.
      d. Members more than 2 foot-0 inch deep: Plus or minus 1 inch.
      e. Crosswise of members: Space evenly within 2 inch of stated separation.
      f. Lengthwise of members: Plus or minus 2 inch.
   2. Maximum bar relocation to avoid interference with other reinforcing steel, conduits or other embedded item: 1 bar diameter.

1.04 SUBMITTALS
A. Shop Drawings: Include complete bending diagrams, assembly diagrams, splicing and laps, and rods, shapes, dimensions, and details of bar reinforcing and accessories.

1. Show diagrammatic elevations of walls at scale large enough to clearly show position and erection marks of marginal bars, around openings, dowels, splices, etc., for these bars.

2. Show complete layout plan for each layer of reinforcing of structural slabs and beams showing number, arrangement, spacing, location, marking, orientation, etc., of reinforcement required for layer being described.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver reinforcement to project site in bundles marked with metal tags indicating bar size, length, and mark.

B. Unload reinforcing carefully to prevent damage. Store above ground in dry, well drained area; protect from mud, dirt, and corrosion.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars: ASTM A615, deformed billet steel bars, domestic manufacture, Grade 60 and as indicated on structural drawings.


C. Metal Accessories: Include spacers, chairs, bolsters, ties and other devices necessary for properly placing, spacing, supporting and fastening reinforcement in place, conforming to requirements to CRSI "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Metal accessories shall be galvanized where legs will be exposed in finished concrete surfaces.

D. Tie Wire: FS QQ-W-461, black enameled steel, 16 ga. min.

2.02 FABRICATION

A. In accordance with CRSI "Manual of Standard Practice".

PART 3 - EXECUTION

3.01 PREPARATION

A. Cleaning: Before placing in work, thoroughly clean reinforcement of loose rust, mill scale, dirt, oil and other coating which might tend to reduce bonding. Reinspect reinforcing left protruding for future bonding, or following delay in work, and reclean if necessary.

3.02 INSTALLATION
A. Bar Placement: In accordance with ACI 301, ACI 318 and CRSI "Manual for Standard Practice".

1. Bending: Bend bars cold; do not heat reinforcing or bend by makeshift methods. Discard bent, kinked or otherwise damaged bars.
2. Splices: In accordance with ACI 301 and ACI 318.
3. Place to provide an additional ½ inch cover on bars immediately adjacent to recesses where ½ inch edge will be cut back for floor mat inspection.

B. Wire Fabric Placement:

1. Install in longest practicable length.
2. Do not make end laps midway between supporting beams, or directly over beams of continuous structures.
3. Offset end laps in adjacent widths to prevent continuous lap.
5. All wire fabric shall be delivered in flat sheets, not rolled.

END OF SECTION 03 20 00
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Cast in-place concrete foundations, floors, and slabs on grade.
2. Concrete admixtures, accessories, joint devices, and materials.
3. Concrete mixing and mix design.
4. Concrete topping over metal decking.
5. Concrete in metal pan stair treads and landings.
6. Contractor advance notification to Architect and Engineer before placing concrete.

B. Work Installed but Not Furnished Under This Section:
1. Section 03 0586 - Vapor Barrier: Installation of Vapor Barrier over granular fill mat.

C. Related Documents:
1. The Contract Documents, General Conditions, and modifications thereto, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.

D. Related Sections:
1. Section 03 1100 - Concrete Forms and Accessories: Forms and accessories for formwork.
2. Section 03 1119 - Insulating Concrete Forming: Concrete storm shelter wall forms.
3. Section 03 2000 - Concrete Reinforcement: Reinforcing for foundations and slabs.
4. Section 03 3500 - Concrete Finishing: Concrete finishes and concrete sealer.
5. Section 05 3100 - Steel Deck: Floor decking for placement of concrete topping.
6. Section 05 5100 - Metal Stairs: Metal pan stair treads and landings.
7. Section 07 9000 - Joint Sealers: Sealant at concrete joints.
8. Section 31 2314 - Building Area Subgrade Pad Preparation: Requirements and procedures for building area subgrade pad.
9. Section 31 2316 - Excavation - Spread and Continuous Footings: Spread footing building foundation.
10. Section 31 2324 - Fill and Backfill: Granular fill mat under floor slab.

1.02 REFERENCES

A. American Concrete Institute (ACI):
2. ACI 301 - Specifications for Structural Concrete for Buildings.
3. ACI 302.2R - Guide for Concrete Floor and Slab Construction.
5. ACI 305R - Hot Weather Concreting.
6. ACI 306R - Cold Weather Concreting.
1. ACI 308 - Standard Practice for Curing Concrete.
2. ACI 309 - Standard Practice for Consolidation of Concrete.
3. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary.

B. American Society for Testing and Materials (ASTM):
1. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
4. ASTM C 42 - Standard Test Method for Obtaining and Testing Drilled Cores and Beams of Concrete.
7. ASTM C 138 - Standard Test Method for Density (Unit Weight), Yield, and Air (Galvimetric) of Concrete.
11. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
12. ASTM C 192 - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
13. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
17. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use in Concrete.

1.03 DEFINITIONS

A. Flat (per ASTM E 1155): Even, plane, homological, free of undulation.

B. Flatness: Relative degree to which a surface conforms to a plane.
C. Level (per ASTM E 1155): Horizontal, normal to the direction of gravity.

D. Levelness: Relative degree to which a surface parallels horizontal.

1.04 SUBMITTALS

A. Section 01 3300 - Submittal Procedures: Requirements for submittals.
   1. Shop Drawings: Submit a Control Joint and Construction Joint plan indicating proposed locations of control joints and construction joints in concrete floor slabs.
      a. Control joint and construction joint plan shall be mechanically drawn to scale.
   2. Assurance/Control Submittals:
      a. Design Data: Submit design mixes for each type and strength of concrete including the following.
         1) Proportions of cement, fine and coarse aggregates, and water.
         2) Combined aggregate gradation.
         3) Aggregate specific gravity and gradations.
         4) Water-cement ratio, design strength, slump, and air content.
         5) Type of cement and aggregates.
         6) Type and proportion of admixtures.
         7) Special requirements for pumping.
         8) Range of ambient temperature and humidity of design.
         9) Any special characteristics of mix which require precautions in mixing, placing, or finishing techniques to achieve finished product.
      b. Test Reports: Submit the following reports directly to Architect at completion of each test. Prepare reports in conformance with Section 01 4500 – Quality Control.
         1) Compressive strength tests for each set of test cylinders.
         2) Slump test for each set of test cylinders.
         3) Air content test for each set of test cylinders.
         4) Unit weight test for each set of test cylinders.
         5) Temperature test for each set of test cylinders.
         6) Floor Flatness and Levelness tests.
   3. Special Inspection Reports: Submit the following inspection reports directly to Building Official and Architect from Independent Special Inspector with copy to Contractor in accordance with requirements of International Building Code, Section 1704 - Special Inspections, if required by the Building Official.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. Installer: Company specializing in concrete work specified with minimum five (5) years documented experience.
   2. Concrete Samples and Slump Tests:
      a. Testing Agency: Sample cylinders taken, and slump test performed by Independent Testing Laboratory personnel.

B. Perform work of this section in accordance with ACI 301 and ACI 318.
C. Acquire cement from same source and aggregate from same source for entire project, unless submitted and reviewed by EOR and Architect.

D. Plant Quality Control:
1. Concrete production facilities shall meet the requirement for certification by the National Ready Mixed Concrete Association.
2. Concrete batchers shall be completely interlocked semi-automatic or automatic batchers, as defined by the Concrete Plan Manufacturer’s Bureau.
3. Concrete batchers shall have graphic, digital, or photographic recorders, which shall register both empty balance and total weight (or volume of water or admixture) of each batched material, time to the nearest minute, date, identification of batch, and numerical count of each batch.

E. Concrete Floor Slab Moisture Emission and Acidity:
1. Do not place or permit placement of underslab granular mat if building area subgrade pad is wet. Place granular mat only when building area subgrade pad area is dry.
2. Do not place or permit placement of underslab vapor barrier over granular mat if granular mat is wet. Place underslab vapor barrier only when granular mat is dry. Refer to Section plan and soil report.
3. Do not add water into transit-mixer at Project site before concrete placement unless instructed by Independent Testing Laboratory representative as specified in this Section.
4. Concrete Contractor is responsible for properly curing concrete floor slab to provide concrete floor slab with moisture emission and acidity test results conforming to each floor material manufacturer requirements for moisture emission and acidity as specified in each floor material specification section when tested in accordance with ASTM F 1869. Refer to each floor material specification section for specific requirements.
5. Apply Moisture Emission and Acidity Control System as specified in Section 03 3906 - Moisture Emission and Acidity Control System. DO NOT apply moisture emission and acidity control system at concrete floor areas scheduled to receive Stained Concrete Finish.

G. Field Sample:
1. Provide ___ foot high x ___ foot long sample panel of concrete wall panel for concrete finish and form bolt design verification.
2. Approved panel finish and form bolt design will establish the standard for acceptable finish and form bolt construction for building cast-in-place concrete wall.
3. Locate sample panel where directed by Architect.
4. Sample shall be portable. Sample shall be prepared and placed so that it can be moved to various locations on project site when directed by Architect.

1.06 DELIVERY, STORAGE AND HANDLING

A. Mix and deliver concrete to project ready-mixed in accordance with ASTM C 94.

B. Schedule delivery so that continuity of any pour will not be interrupted for over 15 minutes.

C. Place concrete on-site within 90 minutes after proportioning materials at batch plant.
1.07 PROJECT CONDITIONS

A. Hot Weather Concreting:
   1. Follow ACI 301 and ACI 305R.
   2. Provide retarding type admixture conforming to ASTM C 494, Type A or D in accordance with manufacturer’s recommendations.
   3. Maximum concrete temperature shall not exceed 95 degrees F at time of placement.
      a. Obtain Engineer’s approval for use of water reducer before using water reducer.
      b. With prior Engineer’s approval, concrete with temperatures above 90 degrees F shall be placed only if a high range water reducer (super plasticizer) is added to the mix as directed the Testing Laboratory to maintain the specified slump during placement.

B. Cold Weather Concreting: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures.
   1. Follow ACI 301 and ACI 306R.
   2. When ambient temperature at site is below 40 degrees F or is expected to fall to that temperature within ensuing 24 hours, heat water and/or aggregate prior to adding to mix so that temperature of concrete will be between 55 degrees F and 85 degrees F at time of placement.
   3. Maintain temperature of deposited concrete between 50 degrees F and 70 degrees F for minimum of seven days after placing.
   4. Temperature Changes: Maintain changes in concrete temperature as uniformly as possible, but in no case exceed change of 5 degrees F per hour or 25 degrees F in any 24-hour period.
   5. Do not use combustion heaters during first 48 hours without precautions to prevent exposure of concrete and workers to exhaust gases containing carbon dioxide and/or carbon monoxide.

C. Select admixture type (normal, retarder, or high early) best suited for concrete at the time of placing. The use of calcium chloride is specifically prohibited.

PART 2 PRODUCTS

2.01 FORMWORK

A. Standard Formwork: Specified in Section 03 1100 - Concrete Formwork and Accessories.

2.02 REINFORCEMENT

A. Specified in Section 03 2000 - Concrete Reinforcement.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C 150, Type I - Normal Portland type.
B. Fly Ash: ASTM C 618; Class C.
   1. Maximum Percentage: 20 percent of cement content by weight.
   2. Architectural Exposed Concrete: Fly ash not permitted.

C. Normal Weight Aggregates: ASTM C 33.
   1. Fine: Clean, hard, durable, uncoated, natural sand, washed, free of silt, loam or clay.
   2. Coarse: Hard, durable, uncoated gravel. Maximum size as follows:
      a. Piers: 1-1/2 inches.
      b. All other Concrete: 1 inch.

D. Water: Potable, clean and free from oil, acid and injurious amount of vegetable matter, alkalis and other impurities conforming to ASTM C 94.

2.04 ADMIXTURES

A. Air Entrainment: ASTM C 260.

B. Water Reducing: ASTM C 494, Type A or D.
   1. Use in accordance with manufacturer’s published instructions and as determined by Testing Laboratory.
   2. Admixture shall not discolor concrete or affect appearance of concrete.
   3. High-range Type F may be used.

C. Calcium Chloride: Not permitted.

2.05 CONCRETE ACCESSORIES

A. Bonding Agent: ASTM C 1059, Type II acrylic non-redispersable type.

B. Non-Shrink Grout: ASTM C 1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Minimum Compressive Strength at 7 Days: 5000 psi.
   2. Minimum Compressive Strength at 28 Days: 7500 psi.

C. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.

2.06 JOINT DEVICES AND MATERIALS

A. Joint Filler: No extruding, resilient asphalt impregnated fiberboard or felt, complying with ASTM D 1751, thickness as indicated on Drawings and width/depth as indicated.

B. Construction Joint Devices: Refer to structural documents for slab joint devices.

C. Sealant and Primer: Specified in Section 07 9000 - Joint Sealers.

2.07 CONCRETE MIX DESIGN
A. Design Criteria:
1. Design concrete mixes in accordance with ACI 318.
2. For each concrete mix type proposed.

B. Proportioning Normal Weight Concrete: Proportions of cement, aggregate, and water to attain required plasticity and compressive strength shall be in accordance with ACI 318.
1. Mix designs furnished by concrete supplier and accompanied by test data showing an acceptable strength history meeting requirement of Method 2 as specified in Section 3.8 of ACI 301.
   a. Temperature of concrete in test data shall be within 5 degrees F of maximum temperature specified for this project.
   b. Strengths indicated in test data shall be in accordance with ACI 318, paragraph 4.3.
   c. Specified strength of concrete used in supporting test data shall vary no more than 500 psi plus or minus from that specified for this Project.
2. Testing Laboratory: Keep strength history record of all concrete for duration of Project.

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

D. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 at rates recommended by manufacturer.

2.08 MIXING

A. Use transit-mixed concrete conforming to requirements of ASTM C 94 and ACI 304. Do not use concrete mixed at Project Site. Do not transport concrete or use concrete in any case after maximum of 90 minutes elapsed after introduction of water into mixer.
1. Temperatures Between 85- and 90-Degrees F: When air temperature is between 85 degrees F and 90 degrees F, reduce mixing and delivery time to maximum 75 minutes.
2. Temperatures Above 90 Degrees F: When air temperature is above 90 degrees F, reduce mixing and delivery time to maximum 60 minutes.

B. Indiscriminate addition of water to increase slump of concrete not permitted.
1. Add water only at direction of Testing Laboratory and/or Architect.
2. Do not add water that increases water cement ratio of concrete more than water cement ratio indicated on approved mix design.
3. At direction of Testing Laboratory addition of a high range water reducing admixture may be used to retemper concrete with specific approval of Architect. Do not use without approval of Architect.

C. Agency supplying transit-mixed concrete shall have plant of sufficient capacity and adequate transportation facilities, to assure continuous delivery at rate required. Frequency of deliveries to Project Site shall be sufficient to provide for placing concrete continuously throughout anyone (1) pour.
PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
   1. Verify lines, levels, and dimensions before proceeding with work of this section.
   2. Verify that screeding equipment is calibrated to provide concrete slab to specified flatness and levelness requirements.

B. Report in writing to Architect prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

C. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner. Costs for correcting unsuitable conditions will be at Contractor’s expense.
   1. If Architect or Architect’s Consultants are required to perform additional services caused by Contractor having to correct unsuitable conditions:
      a. Architect will invoice Owner for additional services by the Architect or Architect’s Consultants.
      b. Contractor will pay for Architect’s or Architect’s Consultants additional services by deductive change order.
      c. Change order will be issued deducting the additional services amount from the Contract Sum.

3.02 PREPARATION

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

B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

C. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer’s instructions.

D. Convey concrete from mixer to place of final deposit by methods that prevent separation or loss of ingredients.
   1. Concrete to be conveyed by pumping shall be submitted to Testing Laboratory for evaluation for each class of concrete taken at discharge end of pumping equipment.

E. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design to ensure practically continuous flow of concrete at delivery end without separation of materials.
   1. Use of gravity-flow or aluminum chutes or conveyors for transporting concrete horizontally not permitted.
3.03 ADVANCE NOTIFICATION TO ARCHITECT AND ENGINEER

A. Contractor shall notify Architect and Engineer 36-hours, and no later than 24-hours, before start of concrete placement operations to provide Engineer sufficient time to travel to Project Site and observe Contractor preparations for concrete placement.
   1. Placing concrete without notification of Architect and Engineer will make Contractor liable for any additional testing or removal and replacement as directed by Engineer.

3.04 ADVANCE NOTIFICATION TO INDEPENDENT TESTING LABORATORY

A. Contractor shall notify independent testing laboratory minimum 36-hours, and no later than 24 hours, before start of concrete placement operations.

3.05 PLACING CONCRETE

A. Independent testing laboratory ACI Concrete Laboratory Technician - Grade 1 shall be at Project Site, ready for start of concrete placement, observations, taking samples and performing specified tests before arrival of first concrete transit-mix truck and start of concrete placement.

B. Project Field Superintendent shall measure air temperature before ordering concrete to determine if hot weather or cold weather concreting measures are required. Record air temperature in Superintendent's Daily Log.

C. Place concrete when weather is dry. Concrete placement not permitted during rain or when footing excavation, vapor barrier, granular mat or subgrade are wet. After rain, allow footings, vapor barrier, granular mat or subgrade to dry thoroughly before placing concrete.

D. Footing excavation shall be dry. Concrete placement not permitted if footing excavation is wet or has standing water.

E. Place concrete in accordance with ACI 304R.

F. Place concrete for floor slabs in accordance with ACI 302.2R.

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

H. Place concrete in uniform layer, approximately horizontal, and not more than 18 inches deep, exercising care to avoid vertical joints or inclined planes.
   1. Piling up of concrete in forms in a manner to cause separation or loss of any of its ingredients not permitted.
   2. Concrete which has partially set or hardened shall not, under any circumstances, be deposited in Work.

I. Placing Concrete in Forms: Place concrete in forms as nearly in its final position as is practical to avoid rehandling. Deposit concrete in horizontal layers maximum 24 inches and in a manner to avoid inclined construction joints. Exercise special care to prevent splashing forms or reinforcement with concrete.
1. Remove any hardened or partially hardened concrete which has accumulated on the forms or reinforcement before the work proceeds.
2. Do not place concrete on previously deposited concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the respective member of section, except as hereinafter specified.
3. Consolidate placed concrete by mechanical vibrating equipment.

J. Placing Concrete Slabs: Place and consolidate concrete slabs in continuous operation, within limits of construction joints, until completion of panel or section placement.
   1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
   2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or derbies to smooth surface free of humps or hollows. Do not disturb slab surfaces before beginning finishing operations.
   3. Maintain reinforcing in proper position on chairs during concrete placement.

K. Do not permit concrete to drop freely any distance greater than five (5) feet. Where longer drops are necessary, use a chute, tremie, or other acceptable conveyance to assist the concrete into place without separation. Do not pour directly into any excavations where water is standing.

L. Vibration: As soon as concrete is deposited, thoroughly agitate same by means of mechanical vibrators and suitable hand tools, so manipulated as to work the mixture well into all parts and corners of the forms, and entirely around the reinforcement and inserts.
   1. Mechanical vibrators shall maintain frequencies in accordance with the recommendations of ACI 309, Table 5.1.4, and shall be operated by competent workmen.
   2. Keep spare vibrator on job site during concrete placing operations.

M. Bonding: Before depositing any new concrete on or against previously deposited concrete which has partially or entirely set, the surface of the latter shall be thoroughly roughened and cleaned of all foreign matter, scum and laitance. Coat surface of previously deposited concrete with a bonding agent per manufacturer’s direction.

N. Separate slabs on grade from vertical surfaces with joint filler.

O. Place joint filler in floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

P. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface.

Q. Install joint devices in accordance with manufacturer's instructions.

R. Locate construction joints in coordination with floor slab pattern placement sequence. Provide keyways minimum 1-1/2 inches deep in walls and slabs and between walls and footings.
   1. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless indicated otherwise.
2. Except as otherwise specifically indicated on Structural Drawings, each concrete member shall be considered as a single unit of operation, and all concrete for the same shall be placed continuously in order that such unit will be monolithic in construction.

3. Should construction joints prove to be absolutely unavoidable, same shall be located at or near the midpoints of spans.

4. Additional construction joints shall not be made under any circumstances without prior review by the Architect and Structural Engineer.

5. Use bonding agent on existing concrete surfaces joined with fresh concrete.

S. Saw cut joints within 8 hours after placing. Use 3/16-inch-thick blade, cut into 1/4 depth of slab thickness.

T. Screed floors level, maintaining specified surface Flatness and Levelness.

U. Fill in holes and openings left in concrete structures for passage of Work by other trades, unless otherwiseshown or directed, after Work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction.

V. Provide monolithic finish to interior curbs by stripping forms while concrete is green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

W. Provide machine and equipment bases and foundations as indicated on Drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

X. Provide concrete fill for steel pan stair treads, landings and associated items. Cast-in safety inserts and accessories as indicated on Drawings. Screed, tamp and trowel-finish concrete surfaces.

Y. Protect all freshly placed concrete from washing by rain, flowing water etc. Do not allow the concrete to dry out from the time it is deposited in the forms until expiration of curing period.

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

3.06 CONCRETE FINISH MEASUREMENT AND TOLERANCES

A. Two-Tiered Measurement Standard: Each floor test section and the overall floor area shall conform to the two-tiered measurement standard as specified herein.

1. Minimum Local Value: The minimum local FF/FL values represent the absolute minimum surface profile that will be acceptable for any one test sample (line of measurements) anywhere within the test area.

2. Specified Overall Value: The specified overall FF/FL values represent the minimum values acceptable for individual floor sections as well as the floor as a whole.

B. Floor Test Sections:
1. A floor test section is defined as the smaller of the following areas:
   a. The area bounded by column and/or wall lines.
   b. The area bounded by construction and/or control joint lines.
   c. Any combination of column lines and/or control joint lines.
2. Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines, as defined by ASTM E1155, at a spacing to be determined by the Owner's testing agency.
3. The precise layout of each test section shall be determined by the Owner's testing agency.

C. Concrete Floor Finish Tolerances:
   1. The following values apply before removal of shores. Levelness values (FL) do not apply to intentionally sloped or cambered areas, nor to slabs poured on metal deck or precast concrete.
      a. Suspended/Structured Slabs:
         1) Floors to be covered with carpet or vinyl tile, unless otherwise specified
            a) Overall Value FF25/FL20
            b) Minimum Local Value FF17/FL15
         2) Interior vehicle exposed concrete floors:
            a) Overall Value FF20/FL15
            b) Minimum Local Value FF15/FL10
         3) Floors to be covered with thin-set tile:
            a) Overall Value FF35/FL20
            b) Minimum Local Value FF24/FL15
         4) Mechanical rooms, recessed floors, and mezzanine slabs:
            a) Overall Value FF20/FL15
            b) Minimum Local Value FF15/FL10
         5) Exposed polished concrete floors: Refer to Division 03, Section "Polished Concrete Floor Finishing".

D. Floor Elevation Tolerance Envelope:
   1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:

3.07 FIELD QUALITY CONTROL

A. Concrete Floor Flatness and Levelness:
   1. Measurement Standard: Floors shall be measured for flatness and levelness according to ASTM E1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System." Tolerances are specified in Section 03 30 00.
   2. Time Period for Measuring and Reporting: All measurements shall be made by the testing laboratory or designated agency before the end of the next workday after the completion of finishing operations. For structural elevated floors, measurement shall also be made prior to removal of forms and shores. The Contractor shall be notified immediately after the measurements of any section are complete, and a written report of the floor measurement results shall be submitted within 72 hours after finishing operations are complete. The
Contractor shall take immediate action to correct any work that is outside the specified tolerances.

3. Measuring Equipment: The concrete surface profile shall be measured using equipment manufactured for the purpose, such as the Dipstick Floor Profiler, as manufactured by the Edward W. Face Company, Norfolk, Virginia, or by other methods specified in ASTM E1155.

4. Floor Test Sections:
   a. A floor test section is defined as the smaller of the following areas:
   b. The area bounded by column and/or wall lines.
   c. The area bounded by construction and/or control joint lines.
   d. Any combination of column lines and/or control joint lines.
      1.) Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines.
   e. The precise layout of each test section shall be determined by the testing agency and shall be submitted for the Architect's review and approval.

3.08 CONCRETE FINISHING

A. Specified in Section 03 3500 - Concrete Finishing.

3.09 FIELD QUALITY CONTROL

B. Section 01 4523 - Testing and Inspection Services:
   1. Tests: Perform the following tests.
      a. Compressive Strength Tests: Perform minimum one (1) test for each 100 cubic yards or fraction thereof, of each mix design of concrete placed in any 1 day.
         1) Test Cylinders: Mold and curve 4 specimens from each set of samples in accordance with ASTM C 31.
         2) Tests: Each set of four (4) cylinders.
      b. Slump Tests: Perform one (1) slump test for each set of samples in accordance with ASTM C 143 or as directed by Architect.
         1) Additional slump tests may be required as directed by Architect.
      c. Air Content Tests: Perform one (1) test for each set of samples in accordance with ASTM C 231 or ASTM C 173.
      d. Unit Weight Tests: Perform one (1) test for each set of samples in accordance with ASTM C 138.
      e. Temperature Tests: Measure temperature of concrete sample for each set of samples.
      f. Floor Flatness and Levelness Tests: Perform tests using measuring equipment in accordance with ASTM E 1155.
         1) Floor flatness and levelness test results shall be reported to Architect and Contractor within (12) hours after testing.
      g. Test Results: Testing Laboratory shall report test results in writing to Architect and Contractor within (24) hours of test.
   1. Inspections: Perform the following inspections.
a. Batch Inspection and Monitoring Water: Inspect each batch of concrete, monitor addition of mixing water to assure uniform consistency from truck to truck. Check mixing from mixers before mix begins to set and within time limits set forth in ASTM C94.

1) Monitor addition of water to concrete at job site and length of time concrete is allowed to remain in truck during placement.
2) Certify each delivery ticket indicating class of concrete delivered, amount of water added and time at which cement, and aggregate was discharged into truck, and time at which concrete was discharged from truck.

2. Test Procedures:
   a. Sample Technician: Test cylinders and slump tests performed only by person holding a current ACI Concrete Laboratory Technician - Grade 1 Certification.
   b. Sampling: Secure composite samples in accordance with ASTM C 172. Each sample shall be obtained from a different batch of concrete on a random basis, avoiding any selection of the test batch other than by a number selected at random before commencement of concrete placement.
   c. Pumped Concrete Samples: Specimens for pumped concrete shall be taken at the discharge end of pumping equipment.
   d. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.

3. Test Reports:
   a. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
   b. Any deviations from the requirements of ASTM Specifications shall be recorded in the test report. Test concrete specimens in accordance with ASTM C 39.
   c. Should strength of concrete fall below the minimum, then additional tests, including load tests, may be required. These tests, if required, shall be made at Contractor’s expense and shall be in accordance with ASTM C42 and ACI 318. If tests do not meet applicable requirements, then structure, or any part of structure, shall be removed and replaced at Contractor’s expense.
   d. Test reports shall include but not be limited to the following information:
      1) Date of concrete placement.
      2) Concrete mix identification number or proportions of ingredients.
      3) Truck ticket number.
      4) Time test was made.
      5) Time of batching.
      6) Location of each placement.
      7) Slump.
      8) Unit weight and air content of concrete sampled.
      9) Date and results of strength test.
   e. Report promptly to Architect all details of reasons for rejection of any and all quantities of concrete. Give all information concerning locations of the concrete pours, quantities, date of pours, and other pertinent facts concerning concrete represented by the specimens.
   f. Any concrete testing requested by the Contractor for early formwork or shoring removal, etc., shall be at Contractor’s expense.
   g. Furnish a statistical analysis for each class of concrete placed on the project in accordance with ACI 214 and ACI 318. Information shall be updated and
distributed once a month as directed by Architect. Information shall include, but not be limited to, the following:

1) Strength test at Seven (7) days.
2) Strength tests at (28) days of two (2) cylinder averages.
3) 28-day moving average strength tests of last three (3) test groups.
4) Standard deviation and coefficient of variation based on (28) day strength tests.
5) Average strength and number of (28) day tests for most recent month.

h. Reports: Prepare and submit test and inspection reports indicating results of tests and inspections made as specified in Section 01 4500 - Quality Control.

C. Inspections by Authority Having Jurisdiction:
   1. Do not place concrete until footings, foundations and concrete under-slab work has been inspected and approved by Authority Having Jurisdiction.
   2. Notify Building Official Having Jurisdiction minimum number of days in advance of inspection as required by Authority Having Jurisdiction to schedule Inspection. Verify with Authority Having Jurisdiction.
      a. footing and Foundation Inspection: Schedule inspection of footings and foundations after excavations for footings are complete and reinforcing steel is in place. For concrete foundations, forms shall be in place before inspection.
      b. Under-Slab Inspection: Schedule inspection of under-slab work after under-slab reinforcing steel is in place, but before any concrete is placed.
   3. Re-inspections: Whenever inspections find that excavations, reinforcing or formwork does not pass tests or inspections, make required corrections and schedule a re-inspection.
   4. Reports: Prepare and submit inspection reports indicating results of tests and inspections made as specified in Section 01 4500 - Quality Control.

D. Correct deficiencies in products and installation found not to be in compliance with Contract Documents.

3.10 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.

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

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

D. Failed Strength Tests: If compressive strength tests indicate results below specified strength, Architect may require any or all the following corrective measures be performed at Contractor's expense. Architect will determine extent of concrete removal if required.
   1. Change concrete mix.
   2. Core test in conformance with ASTM C 42.
   3. Load test on portion or portions of structure where test cylinders indicate concrete is below specified strength. Load testing performed in conformance with ACI 318.
   4. Remove and replace concrete below specified strength.
END OF SECTION 03 30 00
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete formwork.
   2. Concrete reinforcement.
   4. Concrete finishing.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary requirements.
   2. Section 32 13 14 - Landscape Concrete Paving.

1.2 REFERENCES

A. American Concrete Institute (ACI):
   1. 301 - Structural Concrete for Buildings.
   2. 302.1 - Guide for Concrete Floor and Slab Construction.
   3. 305R - Hot Weather Concreting.
   4. 306R - Cold Weather Concreting.
   5. 318 - Building Code Requirements for Structural Concrete.

B. ASTM International (ASTM):
   1. A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and
      Steel Products.
   2. A615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete
      Reinforcement.
      and Deformed, for Concrete.
      Concrete.
      Fillers for Concrete Paving and Structural Construction.

C. Concrete Reinforcing Steel Institute (CRSI) - Manual of Practice.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Descriptive data for color admixture and curing compound.
2. Shop Drawings:
   a. Include pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
   b. Show means of leakage prevention for concrete exposed to view in finished construction.
   c. Show sequence and timing of erection and stripping.
3. Concrete Mix Designs: Submit for each type of concrete.

1.4 QUALITY ASSURANCE

A. Concrete Mix Design: In accordance with ACI 301, Method 1 or 2.

1.5 DELIVERY, STORAGE AND HANDLING

A. Mix and deliver concrete to project ready mixed in accordance with ASTM C94.

B. Schedule delivery so that pours will not be interrupted for over 15 minutes.

C. Place concrete on site within 90 minutes after proportioning materials at batch plant.

PART 2 PRODUCTS

2.1 MATERIALS

A. Formwork:
   1. Forms: Wood, metal, or glass fiber type, tight fitting.
   2. Fasteners: Size as required, sufficient strength to maintain forms in place while concrete is placed.
   3. Form release agent: Nonstaining, colorless mineral oil that will not absorb moisture, stain concrete, or impair adhesion of coatings to be applied to concrete.
   5. Form ties: Snap off type, adjustable length, 1 inch back break dimension, free of defects that could leave holes larger than 1 inch in concrete.

B. Reinforcement:
   3. Chairs, bolsters, bars supports, and spacers:
      a. Sized and shaped for support of reinforcement during concrete placement.
      b. Plastic coated steel for surfaces exposed to weather.
   4. Tie wire: Annealed steel, 16 gage minimum.

C. Concrete Materials:
   1. Portland cement: ASTM C150, Type I or III as applicable.
      a. Fine: Natural sand, free from silt, loam, and clay.
      b. Coarse: Crushed stone, maximum size No. 467, Table No. 2.
   3. Admixtures:
      a. Water reducing or water reducing/set retarding: ASTM C494, Type A or D.

D. Expansion Joint Filler: ASTM D1752, Type 1, non asphaltic.
E. Non Shrink Grout: Premixed, consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; 7,000 PSI compressive strength at 28 days.

F. Curing Materials:
   2. Curing paper: ASTM C171, waterproof paper or polyethylene film.

G. Bonding Agent: Two component modified epoxy resin.

H. Water: Clean and potable.

2.2 MIXES
A. Proportions: In accordance with ACI 301.

B. Design concrete to yield following characteristics unless otherwise indicated:
   1. Minimum 28 day compressive strength: 3000 PSI.
   2. Slump:
      a. Footings: 4 to 6 inches.
      b. Other uses: 3 to 5 inches.
   3. Air entrainment: Provide air entraining admixture to produce 4 to 6 percent air by volume of concrete.

2.3 FABRICATION
A. Reinforcing: In accordance with CRSI Manual.

PART 3 EXECUTION

3.1 PREPARATION
A. Notify Owner, Landscape Architect, and Testing Laboratory minimum 24 hours prior to placing concrete.

B. Remove water and debris from forms and excavations before concrete is deposited.

C. Provide devices for conveying concrete to point of deposit to prevent disturbing forms or reinforcing or segregating concrete.

D. Clean reinforcement of loose rust, mill scale, dirt, oil, and other materials that could reduce bonding.

E. Prepare previously placed concrete surfaces by cleaning with steel wire brush and applying bonding agent in accordance with manufacturer’s instructions.

F. Where new concrete is doweled to existing, drill holes in existing concrete, insert steel dowels, and pack holes solid with non shrink grout.

3.2 INSTALLATION OF FORMWORK
A. Construct forms tight to prevent loss of mortar.
B. Clean contact and screed surfaces of hardened concrete and foreign materials prior to assembly.

C. Apply form release agent to contact surfaces; follow manufacturer's instructions.

3.3 INSTALLATION OF REINFORCEMENT

A. Bar Reinforcement: In accordance with ACI 301 and CRSI Manual.

B. Wire Fabric:
   1. Install in longest practical length.
   2. Offset end laps in adjacent widths to prevent continuous lap.

3.4 PLACEMENT OF CONCRETE

A. Place concrete in accordance with ACI 301 and ACI 318.

B. Ensure reinforcement, inserts, and embedded parts are not disturbed during concrete placement.

C. Deposit concrete as nearly as possible in its final position to minimize handling and flowing.

D. Place concrete continuously between predetermined expansion, control, and construction joints.

E. Do not place partially hardened, contaminated, or retempered concrete.

F. Do not allow concrete to free fall over 8 feet; provide tremies, chutes, or other means of conveyance.

G. Consolidate concrete with mechanical vibrating equipment. Hand compact in corners and angles of forms.

H. Screed slabs to flatness tolerance of 1/4 inch in 10 feet.

3.5 FORM REMOVAL

A. Remove forming materials in manner that will not damage surfaces of concrete; patch work damaged during form removal operations.

B. Provide shoring and bracing as required.

3.6 PLACEMENT OF GROUT

A. Remove loose and foreign matter from concrete; lightly roughen bonding surface. Thoroughly wet concrete surfaces; remove excess water.

B. Mix grout in accordance with manufacturer's instructions. Do not retemper.

C. Place grout continuously, by most practical means; avoid entrapped air. Do not vibrate grout.

3.7 FINISHING

A. Concealed Formed Surfaces: Leave texture imparted by forms.
B. Exposed Formed Surfaces: While concrete is still green:
   1. Patch voids over 1/2 inch in diameter or depth.
   2. Remove fins and other protrusions by rubbing with carborundum stone.

C. Slabs:
   1. Finish surfaces in accordance with ACI 301 and ACI 302.1.
   2. Finish surfaces as specified in Section 32 13 13.

D. Allowable Tolerances: In accordance with ACI 301.

3.8 PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold
   temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary
   for hydration of cement and hardening of concrete.

C. Provide artificial heat to maintain temperature of concrete above minimum specified temperature for
   duration of curing period.

D. Keep forms sufficiently wet to prevent cracking of concrete or loosening of form joints.

3.9 CURING

A. Cure concrete in accordance with ACI 308:
   1. Horizontal surfaces: Use either curing paper or curing compound method.
   2. Vertical surfaces: Use either wet curing or curing compound method.

3.10 CLEANING

A. Remove efflorescence, stains, oil, grease, and foreign materials from exposed surfaces.

END OF SECTION 03 30 53
SECTION 03 35 00 - CONCRETE FINISHES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY
A. Section Includes:
   1. Concrete finishes.
   2. Curing products.
   3. Concrete sealers and hardeners.
B. Related Sections include the following:
   1. Division 3 Section - Cast-in-Place Concrete.
   2. Division 3 Section “Polished Concrete Floor Finishing”.
   3. Division 7 Section “Joint Sealants”.

1.03 REFERENCES
A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
   1. ACI 301 - Specifications for Structural Concrete for Buildings
   2. ACI 302 - Guide for Concrete Floor and Slab Construction
   3. ACI 117-10 – Specification for Tolerances for Concrete Construction and Materials
   4. ASTM E1155 - Determining Floor Flatness and Levelness Using the F-Number System (Inch-Pound Units).

1.04 QUALITY ASSURANCE
A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
B. Product Data: Submit manufacturer's data showing compliance with the specifications.
C. Mockups: Build concrete mockups to demonstrate typical joints, surface finish, texture, and standard of workmanship.
   1. Build finish mockups approximately as 8'x8'x4" temporary slabs for Owner's review and approval of apparatus bay finish texture.
   2. If Architect determines that mockups do not meet requirements, demolish and remove them from the site and cast others until mockups are approved.
   3. Refer to Division 03 Section "Polished Concrete Floor Finishing" for polished slab mockups.
D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
   1. The Contractor shall call a meeting to review the detailed requirements for floor construction, including the concrete placing techniques, finishing techniques, curing techniques, and the application of floor finishing materials. All contractors involved in the floor installation shall attend the conference.
2. Contractor shall verify that the planned concrete finish measurements and tolerances are acceptable for the flooring material and product specifications.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage, mixing with other components, and application.
B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.06 PROTECTION
A. Protect exposed concrete finishes from damage and soiling by other trades. Mask surfaces with polyethylene film as required. Cover exposed concrete floors to receive sealed finish to protect against spillage of grease, paint, pitch, and other harmful substances. Alternate protection methods may be used if approved by Architect in writing.

PART 2 - PRODUCTS

2.01 FLOOR AND SLAB SEALANT TREATMENTS
A. Concrete Sealers, Hardeners and Coatings: Coordinate requirements of hardener/densifier products with concrete mix designs and chemical admixtures and curing methods. These products are chemically reactive with the free lime in concrete and performance and appearance will be adversely affected by chemicals that react with lime or that impede the ability of the hardener/densifier to react. Do not use chemical admixtures or curing compounds unless specifically approved in writing.
1. Exposed concrete floor slabs with light broom finish: Two- or Multiple-Coat, spray-applied, hardener/densifier. Chemical reactive magnesium fluorosilicate formulation with chemical resistant properties to alkali, acids, oils and salts, and does not substantially change appearance of concrete surfaces. Provide one of the following or approved equal product by another Manufacturer:
   a. MasterKure HD 300 WB by BASF.
   b. "Surf-Hard" by Euclid Chemical Co.
2. Exposed concrete floor slabs with smooth troweled finish: One coat flood-applied, hardener/densifier. Chemical reactive silicate / silicate formulation that enhances sheen level of troweled concrete and is designed to maintain or increase sheen level over time with normal wear. Provide one of the following or other comparable product by another Manufacturer:

2.02 RELATED MATERIALS
A. Semi-rigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A Shore durometer hardness of 80 per ASTM D 2240.
B. Sawcut joint filler: Euco 700 epoxy by The Euclid Chemical Company, or approved equal.
C. Refer to Division 03 Section “Cast in Place Concrete”, for patching materials and other materials related to non-polished concrete.
D. Refer to Division 03 Section “Polished Concrete Floor Finishing” for materials related to polished floors.
E. Sealants: Refer to Division 07 “Joint Sealants”.
F. Floor Leveling Compound: Where required for existing rough and uneven floors as an underlayment for tile or other floor finishes. Hydraulic Cement Underlayment, provide Latex base liquid emulsion with Portland Cement and sand, as made by Camp's, MAPIE, Henry or Sonocrete.

PART 3 - EXECUTION

3.01 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.
1. Concrete slabs shall be finished as specified below, within the tolerances specified elsewhere in this Section.
2. Coordinate concrete placement and finishing with the requirements of section 03 30 00 Cast-In-Place Concrete and section 03 35 36 Polished Concrete Floor Finishing. The most restrictive requirement shall govern and be followed.
3. Highway straightedges are recommended for use in lieu of bullfloats for all slab placement and finishing operations.
4. Screeding: Immediately after placing, slab shall be vibrated and struck off true by double screeding to the required level, at or below the elevation or grade of the finished slabs as indicated on the Drawings.
5. Vibrators shall not be used to spread the concrete. When camber is indicated for slabs supported on formwork, screed to the required camber. Fixed screed guides are recommended where specified surface tolerance exceeds FF25/FL20.
6. Takes care when using vibrators at polished floor slabs to ensure vibrator is not in contact with reinforcing which could cause “ghosting” of the reinforcing in the polished slab finishes. Coordinate requirements with the polished floor finish applicator.
7. Floating: Immediately after screeding, before any excess bleed water is present on the surface, float the surface using long-handled bull floats or darbies.
8. Straightedging: Immediately after screeding and before excess bleed water is present on the surface, straighten the surface using a highway straightedge.
9. Edging and jointing, where required, shall be done after bleed water has evaporated and before further finishing.

B. 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 restraighten until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing or sand-bed.
2. Locations: All concrete surfaces under waterproofing membrane, setting beds for stone and pavers.

C. Preparation: As soon as forms are removed, remove undesired fins and other projections, level offsets, and saturate voids or damaged places immediately with water and repair with mortar of same composition as used in mix. Apply applicable finish as specified below, where scheduled and shown on 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 exposed to view or to be covered with ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film- finish coating system.
2. Locations: Exposed concrete floors not specified to be polished.
E. Horsehair Finishes: Apply a first trowel finish to surfaces where ceramic tile is to be installed by either thickset or medium/thin-set methods. While concrete is still plastic, slightly scarify surface with a fine broom.
   1. Comply with flatness and levelness tolerances for trowel finished floor surfaces
   2. Locations: All concrete surfaces under ceramic tile finish.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and 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.
   2. Locations: All exterior sidewalks, concrete pads, shade structures, and composting restrooms.

3.02 FINISHING EXPOSED CONCRETE SURFACES

A. General: Provide aesthetically pleasing concrete finish as judged by Architect for the following applications, and as herein specified:
   1. Exposed surface of light or flag pole bases and similar conditions.
   2. Exposed interior concrete grade beams or elevation changes, slab edges and similar conditions.
   3. Areas of exposed exterior grade beams or slab edges at building perimeter and/or dumpster enclosure.
   4. Concrete turn-down/retaining edge at rear paving areas.

B. Preparations: As soon as forms are removed, remove undesired fins and other projections, level offsets, and saturate voids or damaged places immediately with water and repair with mortar of same composition as used in mix. Apply applicable finish as specified below, where scheduled and shown on Drawings.

C. 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 texture. Do not apply cement grout other than that created by the rubbing process. Continue surface treatment of adjacent similar formed surfaces until finish is uniform, unless otherwise indicated.
   1. Exposed surfaces of concrete grade beams.
   2. Concrete plinth bollards.
   3. Turn-down (retaining) edges of paving (at tall face only).

D. Parged Finish: Provide at vertical surfaces exposed to view in completed work as specified herein and any other locations as indicated in Drawings.
   1. After removal of forms, patching, and repairing, and while concrete is still green, spread slurry consisting of 1 part Portland cement and 1-1/2 part damp, loose sand by volume, over pre-dampened surface. Apply using burlap pads or sponge rubber floats. Remove surplus material, and then rub with clean burlap. Finished rubbed surface shall be uniformly smooth, entirely free of pits, holes, or form marks and similar in texture to sand finished limestone. Large surface swirls or heavily textured surfaces are not acceptable.
   2. Locations: Light pole bases. Protect masonry below, floor, and other adjacent finishes, from soiling when parging interior concrete.

E. Paint the following surfaces in color(s) as selected by architect to match or complement adjacent surfaces:
   1. Exposed grade beams where more than 6” is exposed.

3.03 LIQUID FLOOR TREATMENTS
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. Do not apply to concrete that is less than 14 days' old. Do not apply in areas adjacent to those scheduled to receive polished concrete floor finish until there are solid walls and protection in place between these areas or until after polished concrete floor finishing is complete. Protect finished polished floors from contamination by the application of this product, inadvertent or otherwise.
   3. Apply spray application product in two or more coats, in accordance with Manufacturer's application instructions.
   4. Apply flood application product (smooth troweled finished floor surfaces) 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 in accordance with Manufacturer's installation instructions if surface is still rough or porous.

3.04 SUBFLOOR MAINTENANCE AND PREPARATION
A. Prior to installation of finish floor coverings, remove dirt, oil, grease, paint and other foreign matter from surfaces. Inspect for holes, cracks and other abrasions and fill such defects with latex floor leveling compound. Disc-sand high spots and abrasions.

3.05 CONTROL JOINTS
A. Saw-cut Control Joints: Form weakened-plane control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into concrete slab when cutting action will not tear, abrade, or otherwise damage surface and before random contraction cracks develop.
B. Construct control joints for a combined depth equal to topping thickness and not less than one-fourth of base-slab thickness, unless otherwise indicated.

3.06 JOINT FILLING
A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
B. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
C. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
D. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint afterhardening.
   1. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.07 CONCRETE FINISH MEASUREMENT AND TOLERANCES
A. Two-Tiered Measurement Standard: Each floor test section and the overall floor area shall conform to the two-tiered measurement standard as specified herein.
   1. Minimum Local Value: The minimum local FF/FL values represent the absolute minimum surface profile that will be acceptable for any one test sample (line of measurements) anywhere within the test area.
   2. Specified Overall Value: The specified overall FF/FL values represent the minimum values acceptable for individual floor sections as well as the floor as a whole.
B. Floor Test Sections:
   1. A floor test section is defined as the smaller of the following areas:
      a. The area bounded by column and/or wall lines.
      b. The area bounded by construction and/or control joint lines.
      c. Any combination of column lines and/or control joint lines.
   2. Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines, as defined by ASTM E1155, at a spacing to be determined by the Owner's testing agency.
   3. The precise layout of each test section shall be determined by the Owner's testing agency.

C. Concrete Floor Finish Tolerances:
   1. The following values apply before removal of shores. Levelness values (FL) do not apply to intentionally sloped or cambered areas, nor to slabs poured on metal deck or precast concrete.
      a. Floors to be covered with thin-set tile:
         1) Overall Value FF35/FL20
         2) Minimum Local Value FF24/FL15
      b. Mechanical rooms, recessed floors, and mezzanine slabs:
         1) Overall Value FF20/FL15
         2) Minimum Local Value FF15/FL10
      c. Exposed polished concrete floors: Refer to Division 03, Section "Polished Concrete Floor Finishing".

D. Floor Elevation Tolerance Envelope:
   1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:
   3. Top surfaces of formed slabs measured prior to removal of supporting shores: +/- 3/4"
   4. Top surfaces of all other slabs: +/- 3/4"
   5. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10'- 0" at any point, up to 3/4" from theoretical elevation at any point.

3.08 FIELD QUALITY CONTROL

A. Concrete Floor Flatness and Levelness:
   1. Measurement Standard: Floors shall be measured for flatness and levelness according to ASTM E1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System." Tolerances are specified in Section 03 30 00.
   2. Time Period for Measuring and Reporting: All measurements shall be made by the testing laboratory or designated agency before the end of the next workday after the completion of finishing operations. For structural elevated floors, measurement shall also be made prior to removal of forms and shores. The Contractor shall be notified immediately after the measurements of any section are complete, and a written report of the floor measurement results shall be submitted within 72 hours after finishing operations are complete. The Contractor shall take immediate action to correct any work that is outside the specified tolerances.
   3. Measuring Equipment: The concrete surface profile shall be measured using equipment manufactured for the purpose, such as the Dipstick Floor Profiler, as manufactured by the Edward W. Face Company, Norfolk, Virginia, or by other methods specified in ASTM E1155.
   4. Floor Test Sections:
      a. A floor test section is defined as the smaller of the following areas:
      b. The area bounded by column and/or wall lines.
      c. The area bounded by construction and/or control joint lines.
d. Any combination of column lines and/or control joint lines.
   1) Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines.
e. The precise layout of each test section shall be determined by the testing agency and shall be submitted for the Architect's review and approval.

3.09 REPAIRS

A. Defective Topping: Repair and patch defective concrete floor topping areas, including areas that have not bonded to concrete substrate.

B. Remedial Measures for Slab Finish Construction not Meeting Specified Tolerances:
   1. Application of Remedial Measures. Remedial measures specified herein are required whenever either or both of the following occur:
      a. The composite overall values of flatness or levelness of any test section or the entire floor installation measure less than specified values.
      b. Any individual test sample (line of measurements) measures less than the specified absolute minimum flatness or levelness value.
   2. Modification of Existing Surface:
      a. If, in the opinion of the Architect or Owner's representative, all or any portion of the substandard work can be repaired without sacrifice to the appearance or serviceability of the area, the Contractor shall immediately undertake the approved repair method.
      b. The Contractor shall submit for review and approval a detailed work plan of the proposed repair showing areas to be repaired, method of repair, and time required to make the repair.
      c. Repair method(s), at the sole discretion of the Architect or Owner's Representative, may include grinding (floor stoning), planing, re-topping with specified floor leveling compound, or any combination of the above.
      d. All repair work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.
   3. Removal and Replacement:
      a. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work cannot be satisfactorily repaired without sacrifice to the appearance or serviceability of the area, the Contractor shall remove and replace the defective work as directed.
      b. Replacement sections may be retested for compliance at the discretion of the Architect/Engineer or Owner's Representative.
   C. All replacement work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

3.10 CLEANING

A. Clean surfaces as required with soap and water until foreign matter and dirt are removed.

END OF SECTION 03 35 00
SECTION 03 35 36 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes: Products and procedures for placement, finishing, and polishing cast-in-place concrete floors, to be installed by a Manufacturer Certified Applicator.
   1. Polished concrete finishing.
   2. Concrete colored Dye
   4. Requirements for placing and curing polished concrete floor slabs.
   5. Pre-Installation Meetings
      a. Pre-Installation Conference
   6. Mockups
      a. Field Sample Panels

B. Note: Initial grinding of exposed aggregate floors shall occur prior to wall framing.

C. Related Requirements:
   1. Division 03, Section "Cast-in-Place Concrete", and other Sections related to floor slab placement and finishing.
   2. Division 03, Section "Concrete Floor Finishing", for application of hardener/densifier at unpolished sealed concrete floors in mechanical and similar spaces.
   3. Division 4 Section "Unit Masonry"
   4. Division 6 Section "Rough Carpentry"
   5. Division 8 Sections "Glazed Aluminum Storefronts and Curtain Walls"

D. Product Data: Manufacturer’s technical literature for each product indicated, specified, or required. Include manufacturer's technical data, application instructions, and recommendations.

E. Samples for Initial Selections:
   1. Manufacturer's color card for concrete dyes.
   2. Aggregates: Labeled, sealed plastic bags with one pound of each aggregate in concrete mix.
   3. Integral Color Pigment: Full range of available standard manufacturers samples of actual products showing colors.

F. Samples for Verification: Submit 12-inch square samples of polished finish in each color, texture, and pattern specified; include not less than 3 in each sample set showing limits of variations expected for each color, texture, and pattern specified. Resubmit samples until approved.
G. Informational Submittals:
   1. Manufacturer's Certification.
   2. Applicator's Qualifications.
   3. Field Quality Control Reports:
      a. Submit Manufacturer's field quality control reports / recommendations for field visits as described by Field Quality Control article.

H. Closeout Submittals: Maintenance Data: For inclusion in operation and maintenance manual required by Division 01. Include manufacturer’s instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use. Include precautions against cleaning products and methods which may be detrimental to polished finishes and performance.

1.03 REFERENCES

1.04 SUBMITTALS
A. Product Data: Manufacturer’s technical literature for each product indicated, specified, or required. Include manufacturer's technical data, application instructions, and recommendations.
B. Samples for Initial Selections:
   1. Manufacturer's color card for concrete dyes.
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C. Samples for Verification: Submit 12-inch square samples of polished finish in each color, texture, and pattern specified; include not less than 3 in each sample set showing limits of variations expected for each color, texture, and pattern specified. Resubmit samples until approved.
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   3. Field Quality Control Reports:
      a. Submit Manufacturer's field quality control reports / recommendations for field visits as described by Field Quality Control article.
E. Closeout Submittals: Maintenance Data: For inclusion in operation and maintenance manual required by Division 01. Include manufacturer’s instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use. Include precautions against cleaning products and methods which may be detrimental to polished finishes and performance.

1.05 QUALITY ASSURANCE

A. Manufacturer's Quality Assurance: Submit manufacturer’s certification that products comply with specified requirements and are suitable for intended application.

B. Applicator's Qualifications:
   1. Supervision: Maintain competent supervisor who is at Project during times specified Work is in progress, and, who is experienced in installing systems similar to type and scope required for Project.
   2. Manufacturer's Certification: Provide letter of certification from sealer/hardener manufacturer stating that the applicator is a certified applicator of the Manufacturer's polishing system and is familiar with proper procedures and installation requirements required by the manufacturer for diamond polishing.
   3. Experience: Company with not less than 5 years continuous experience under the current name in performing specified work similar in design, products, and extent to scope of this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and personnel to produce required Work.
   4. Upon request, submit list of a minimum of 5 completed projects of comparable or greater size and complexity to this Work. Include for each project:
      a. Project name and location.
      b. Name and contact information for Owner.
      c. Name and contact information of General Contractor (if applicable).
      d. Name and contact information of Architect.
      e. Name of Polished Concrete Floor Finish manufacturer.
      f. Approximate square footage of dyed, densified diamond polishing system installed.
      g. Date of completion.

C. Static Coefficient of Friction: Products and polishing operations shall achieve following as determined by quality control testing according to NFSI 101-A:
   1. Level Floor Surfaces, typical: Minimum 0.6, dry.

D. Concrete Producer Qualifications: Firm experienced in manufacturing ready-mixed concrete products and that complies with following requirements for production facilities and equipment:
   1. ASTM C 94.
   2. NRMCA's Certification of Ready Mixed Concrete Production Facilities.

E. Field Mock-up for Aesthetic Purposes: Before performing work of this Section, provide as many field samples as required to verify selections made under submittals and to demonstrate aesthetic effects of polished finish. Approval does not constitute approval of deviations from Contract Documents, unless such deviations are specifically approved by Architect in writing. Provide additional mockups for repair conditions noticed on the floor slabs to be polished.
   1. Polish 100 square feet floor area for each polished finish type.
a. When there is an appropriate area available, and if approved by Architect, mock-ups may be constructed on areas of floor slab not scheduled for polished concrete floor finish, provided that the mock-ups will be concealed by other flooring systems as scheduled, and the mock-up will not adversely affect the installation or performance of the scheduled flooring system for that area. Confirm available locations for such mock-ups prior to pouring slabs to be polished, with Architect and with installer(s) of other flooring system(s). Otherwise, provide temporary minimum size 10'x10'x4" thick concrete pads for mock-ups, poured at same time and of same material as the concrete floor slabs to be polished.

b. When there is an appropriate area available, and if approved by Architect, mock-ups for repair procedures may be constructed on areas of floor slab not scheduled for polished concrete floor finish, provided that the mock-ups will be concealed by other flooring systems as scheduled, and the mock-up will not adversely affect the installation or performance of the scheduled flooring system for that area. If the slab exhibits cracks of a similar nature to cracks existing in the temporary mockup slab, then perform crack repair mockups on the temporary slab.

2. Use the same personnel, including supervisors, which will perform the Work.

3. Install products and materials according to specified requirements and same installation procedures to be used in installation of the Work.

4. Work shall be representative of those to be expected for the Work.

5. Show maximum variation that will be expected to exist in the completed Work.
   a. If there is cracking evident in floor slabs to be polished at time of polishing mock-ups, include crack repair examples in the initial mockups.
   b. Provide mockups for all surface imperfections or surface damage repairs evident in the slab as directed by Architect, at the time that such conditions are observed to exist. It is the intent of these specifications that all surface imperfections in all areas of polished concrete floor finish will be patched as part of the base scope of the work, whether or not the surface imperfections are caused by non-conforming work. Architect shall have discretion to determine which types of surface imperfections will or will not be patched based on results of mockup reviews.

6. Approval is for the following aesthetic qualities:
   a. Compliance with approved submittals.
   b. Uniformity or intended effect of exposed aggregate.
   c. Uniformity of sheen.
   d. Uniformity or intended effect of dyed color.

7. Obtain Architect’s approval before starting work on Project.

8. Maintain field mock-ups during construction in an undisturbed condition as a standard for judging completed Work.

9. Do not demolish, alter, or remove field mock-ups until acceptable to Owner and Architect.

10. When directed, demolish and remove field mock-ups from Project.

F. Pre-Installation Conference: Prior to placing concrete for areas scheduled for polished concrete floor finish, conduct conference at Project to comply with requirements of applicable Division 01 Sections.

1. Required Attendees:
   a. Owner's representative.
   b. Architect.
c. General Contractor, including superintendent for this project.
d. Concrete Floor Polishing System Applicator, including the supervisor for this project.
e. Concrete producer.
f. Concrete Floor Polishing System Manufacturer's field representative.

2. Minimum Agenda: Floor Polishing System Applicator, and other related trades as applicable, shall demonstrate understanding of work required by reviewing and discussing procedures for, but not limited to, following:
   a. Discuss and evaluate compliance with Contract Documents, including substrate conditions, surface preparations, sequence of installation and other preparatory Work performed by other installers.
   b. Review approved submittals.
   c. Review installation procedures, including, but not limited to:
      1) Environmental requirements.
      2) Concrete finishing.
      3) Curing methods.
      4) Surface preparation.
      5) Construction Joints
      6) Repair Procedures.
      7) Field quality control procedures and requirements.
      8) Cleaning.
      9) Protection of polished concrete.
     10) Coordination with other work.
     11) Maintenance.

3. Minutes: General Contractor shall record discussions, including decisions and agreements reached, and furnish copy of minutes to each party attending.

G. Field Quality Control Conferences: Should deficiencies or complications arise requiring a field quality control conference with the Polishing System Manufacturer's Representative, conduct a field quality control conference with adequate notice to same attendees as the Pre-Installation Conference.
   1. Tour mock-ups and representative areas of required work. Discuss and evaluate corrective actions required for compliance with Contract Documents, including substrate conditions, surface preparations, sequence of installation and other repair or preparatory Work performed by polishing system Applicator or other trades.
   2. Manufacturer's field representative shall prepare and issue report to attendees noting decisions made, and follow-up actions and corrective actions required.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original, factory sealed, unopened, new containers bearing manufacturer's name and label intact and legible.

B. Store materials in protected and well-ventilated area at temperatures between 40° and 90° degrees F., unless otherwise required by manufacturer. Keep containers sealed until ready for use. Do not use materials beyond manufacturer’s shelf life limits. Protect materials during handling and application to prevent damage or contamination.

1.07 PROJECT CONDITIONS

A. Damage and Stain Prevention: Take precautions to prevent damage and staining of concrete surfaces to be polished.
   1. Prohibit following over concrete surfaces to be polished:
a. Vehicle parking.
b. Pipe cutting operations.
c. Ferrous metals storage.

2. Protect concrete surfaces to be polished from following:
   a. Petroleum, oil, hydraulic fluid, or other liquid dripping from equipment.
   b. Acids and acidic detergents.
   c. Painting activities.

B. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting polishing operations.

1.08 WARRANTY
A. Sealer/Hardener: Manufacturer's Standard Ten (10) year material warranty and Certified Applicator's Ten (10) year labor warranty for Sealer/Hardener, Jointly signed.

1.09 MAINTENANCE MATERIALS
A. At end of project, provide Owner with five gallons of RetroPlate’s CreteClean Plus, or Manufacturer's recommended cleaning product, and latest published Maintenance brochure for proper maintenance.

PART 2 - PRODUCTS

2.01 MANUFACTURER AND PRODUCTS
A. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents, manufacturers offering products that may be incorporated into Work include, but are not limited to, those listed alphabetically below.

B. Basis of Design: Contract Documents are based on products as manufactured by RetroPlate, (888) 942-3144, www.retroplatesystem.com, to establish a standard of quality. Other available products and installation processes having equivalent characteristics and quality control may be considered, provided deviations are minor and does not change concept expressed in Contract Documents as judged by Architect.

1. Retroplate 99 Densifier / Sealer / Hardener: Advanced Floor Products, Provo UT.
2. Polish Guard, water based copolymer for forced burnishing application: RetroPlate “RetroGuard”, or Floor Polishing System Manufacturer's approved equal product.

2.02 CONCRETE MATERIALS
A. Cementitious Materials: As specified in appropriate Division 03 Section – Cast in Place Concrete.

B. Normal-Weight Aggregates:
   1. Description:
      a. ASTM C 33, Class 2N.
      b. Selected, hard, and durable gravel; free of material that reacts with cement or causes staining.
      c. Uniformly or gap graded to match approved sample.
d. From single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

2. Large Aggregate: 1 inch nominal.

C. Water: ASTM C 94 and potable.

D. Admixtures: As specified in appropriate Division 03 Section.

E. Integral Color Pigment:
   1. Color Selection: As selected by Architect from manufacturer's full range.
   2. Description: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, non-fading, and resistant to lime and other alkalis.
   3. Available Manufacturers:
      a. Davis Colors.
      b. Cathay Industries USA.
      c. Lambert Corporation.
      d. L. M. Scofield Company.
      e. Solomon Colors.

2.03 CURING MATERIALS

A. Water: Potable; applied periodically in mist or fine spray as required in hot or dry weather to keep surface damp during curing, to minimize likelihood of shrinkage cracking and similar imperfections.

B. Curing Blankets / Covers: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd, or as recommended for best results under expected site conditions during curing.

C. Curing agents can leave a film on concrete or react with free lime and cause failure of concrete floor polishing to achieve desired results. Do NOT use any chemical curing agents unless specifically approved in writing by Architect and Concrete Floor Polishing System Manufacturer. Slab shall be moisture cured unless specifically approved otherwise by Architect.

2.04 PENETRATING CONCRETE SEALER/HARDENER

A. "RetroPlate 99 Polishing System", or approved equal. Formulated to seal, dustproof, increase abrasion resistance and develop polished appearance to concrete surfaces to which it is applied.
   1. Description: Clear liquid form of sodium silicate to permanently seal, dustproof and harden concrete surfaces and provide abrasion resistance by penetrating into concrete pores and chemically reacting. Chemically relies on an internal reaction, leaving no surface film or residue to densify pores. Products containing silicatanes, magnesium florsilicates, or potassium silicates [or lithium silicates] will not be acceptable and will not be approved. Products must conform and meet minimum performance characteristics as described herein.
   2. Performance Criteria:
      a. Abrasion resistance: ASTM C779 - Up to 400% increase in abrasion resistance.
      b. Impact Strength: ASTM C805 Ô 21% increase impact strength.
      c. Ultra Violet Light and Water Spray: ASTM G23-81 Ô No adverse effect to ultra violet and water spray.
d. Coefficient of Friction: ASTM C1028 Ó Meet or exceed OSHA and ADA recommendations.
e. Reflectivity: IG Ó 310 Gloss Reader Checker Ó up to 30% increase in reflectivity.
f. Densification: Achieve waterproofing, hardening, dustproofing, and abrasion resistance of the concrete surfaces while imparting specified sheen.

B. Manufacturer's Technical Representative available to make site visits.

C. RetroPlate System Schedule:
   1. Polished Concrete: –Retro Plate 99 Polishing System used in conjunction with integral colored concrete with decorative rock aggregate. Spiff coats: 2 coats Retro Guard.
      a. Level of Grinding: Deep grind, exposed aggregate (approximately 3/8” removed, as approved by mockup review).
      b. Sheen: Level III Mirror Reflective Sheen.
      c. Color: Integral color concrete as selected by Architect from Manufacturer's standard colors, with exposed aggregate, and as approved through mockups.

2.05 JOINT SEALANT, SPALL, AND CRACK REPAIR

A. Crack Repair and Joint Sealant products must meet specification requirements for compatibility with Diamond Polished Concrete Floor Finish System as recommended by manufacturer of concrete sealer/hardener. The following products named are for RetroPlate system and to set quality standard.

B. Surface Refinement Grout: Two-component polyurethane / polyurea rigid structural polymer, 95% solids, low-odor, with shore D hardness 70-75. Metzger / McGuire SRG Surface Refinement Grout with dye pack, or approved equal product acceptable to polishing system Manufacturer.
   1. Color Pack: As selected by Architect and approved by mockup review.

C. Joint Filler / Sealer: Polishing system Manufacturer's recommended self-leveling elastomer joint filler, "CreteFill 85" as manufactured by Curecrete of Springville, Utah, or approved equal.
   1. ASTM D-2240, Shore A hardness.
   2. Rated for heavy vehicle traffic.
   3. Resistant to petrochemicals.
   4. Remains flexible, including in cold temperatures.
   5. Color: Custom color(s) as required to match surfaces and as approved by Architect through mock-up review.

D. Spall and Crack Repair for concrete patching: Polishing system Manufacturer's recommended high strength, hybrid urethane repair material, "CreteFill Crack Repair" and "CreteFill Spall Repair", as manufactured by Curecrete of Springville, Utah, or approved equal.
   1. Can be color-matched to adjacent concrete.
   2. Other type products may be considered if they are demonstrated by mockup to produce superior results.
2.06 ACCESSORIES

A. General: Accessories required for application of Colored Concrete Dye and Diamond Polishing System: Provide in accordance with floor finish system Manufacturer's instructions, including thinners.

B. Neutralizing Agent:
   1. Trisodium Phosphate.
   2. Ammonia.

C. Water: Potable.

D. Protective Covers: Use protective covers approved by Concrete Floor Polishing System Manufacturer. Do not use coverings that are impermeable or would trap moisture in or on the slab surface. Subject to compliance with requirements and Manufacturer's approval, provide the following products:
   1. Continuous protective, water vapor permeable membrane: This membrane is primarily to protect against spill and chemical damage, but may also provide partial protection against physical damage. Install immediately after initial curing period and initial grind are complete, and maintain throughout construction until final polishing operations. Provide one of the following:
         1) Provide seam and perimeter tapes of type as recommended by Manufacturer. Adhesives integral to or used as part of the membrane protection system shall be designed to release from the slab without staining or leaving a residue. Other tapes shall not be applied to the concrete slab.
   2. Protection against physical damage: Membrane protection alone is not considered adequate protection against physical damage to the slab due to construction operations. Whenever there is construction activity over slab areas to be polished, the floor shall be covered with continuous protection boards. The following are acceptable options:
      a. Plywood: Nominal 3/4", plywood. Preservative treated plywood may only be used over continuous protective membrane, and only then with expressed permission of polishing system manufacturer. Otherwise provide untreated plywood and replace as required due to warp or damage by the elements.
      b. Kraft Paper: Non-marking construction Kraft Paper, with tape for seams as required. Tape shall not be applied directly to concrete slabs.
         a. Kraft paper may be used as a stain barrier between slab and protection boards where appropriate, and as may be required to protect slab from ongoing construction operations after the membrane protection is removed.

2.07 MIXING AND TINTING

A. Do not thin sealer/hardener.
2.08 POLISHING EQUIPMENT

A. Field Grinding and Polishing Equipment:
   1. Variable speed, 3 or 4 head counter-rotating, walk-behind machine with not less than 600 lbs of down pressure on grinding or polishing pads.
   2. Dust extraction equipment with flow rate suitable for dust generated, with pre-separator and squeegee attachments.
   3. At slabs with questionable flatness level, use grinding equipment with rotating heads, to minimize uneven aggregate exposure patterns.

B. Edge Grinding and Polishing Equipment: Hand-held or single head walk-behind machines which produces same results, without noticeable differences, as field grinding and polishing equipment.

C. Burnishing Equipment: Single head high speed walk-behind machines.

D. Grinding Pads: Metal bonded pads with embedded industrial grade diamonds of varying grits fabricated for mounting on equipment.

E. Polishing Pads: Resin bonded pads with embedded industrial grade diamonds of varying grits fabricated for mounting on equipment.

F. Burnishing Pads: Maintenance pads coated with embedded industrial grade diamonds for use with burnishing equipment.

2.09 CONCRETE MIX DESIGN

A. Material Quality Standards: Mix designs for each type and strength of concrete used for floors will be prepared as specified in appropriate Division 03 Section, with following qualifications:
   1. Slump Limit: 4 inches, plus or minus 1 inch.
   2. Maximum Water-Cement Ration: 0.45.
   3. Air Content: None permitted.
   4. Admixtures: Calcium chloride based compounds not permitted.
   5. Replacement for Portland cement with fly ash or slag: None permitted.

PART 3 - EXECUTION

3.01 PLACING AND FINISHING CONCRETE FOR FLOORS

A. General: For polished concrete slabs comply with appropriate Division 03 Section requirements, and the following. In the event of conflict, the most restrictive requirements shall prevail.

B. Hot and Cold Weather Placement: As specified in appropriate Division 03 Section.

C. Placement: Deposit and consolidate concrete in 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.
   2. Screed slab surfaces with a straightedge and strike off to correct elevations.
   3. After screeding, consolidating and leveling, do not work surface until ready for floating.

D. Float Finishing:
1. Begin floating operations when water sheen has disappeared, and/or when concrete has stiffened sufficiently to permit proper operation of power-driven equipment.
2. Consolidate surface with power-driven troweling using steel float pans.
3. Hand float with wood or cork faced floats in locations inaccessible to power-driven machine.
4. Level surface using 10 foot highway straightedge.
5. Cut down high spots and fill low spots to produce planes checking true under straightedge in any direction.
6. Bring surface to uniform, smooth, granular texture with power-driven troweling using steel float pans.

E. Floor Flatness & Floor Levelness: F(F) 40 and F(L) 35 according to ASTM E 1155.
   1. Minimum floor flatness Local Limits are the same as above.
   2. Where different floor flatness limits are indicated in Structural Drawings or other concrete specification Sections, the most stringent flatness requirement shall apply for polished concrete slabs.

F. Joints: Saw cut or tool joints to match approved mock-up.

G. Column Leave-Outs: Except where sawcut or tooled joints are specifically detailed in the Drawings:
   1. Provide round column leave-outs where leave-outs will be exposed in finished work, unless otherwise required or directed by Architect.
   2. Wherever column leave-outs will be exposed in the finished polished concrete work, do not tool joints.
   3. Pour leave-outs with same mix design concrete as the adjacent slab and fill flush to 1/32" above adjacent slab.
   4. Feather thinly out over edge of the slab; the feathered edge to be removed by the grinding process to produce a smooth transition with no joint line.
   5. Route joint line using a guide and high speed router with sharp bit so as to minimize possibility of chips and aggregate spalls.
   6. Fill routed joint flush with joint filler material.
   7. Notes:
      a. Small differences in color and/or noticeable differences in finished aggregate exposure pattern between the slab and column leave-outs are typically to be expected due to the nature of concrete and are acceptable.
      b. Router a control joint line with a high-speed router with sharp clean bit and guides to ensure smooth and even joint lines and clean cut, and fill the joint flush with the specified joint filler material.

H. Moisture Curing:
   1. Immediately begin after floating.
   2. Keep concrete surface continuously wet by covering with absorptive cover or by using continuous water-fog spray.
   3. Cover concrete surface with absorptive cover with 4 inch lap over adjacent absorptive covers.
   4. Thoroughly saturate cover with water and keep continuously wet.
   5. Curing compounds will only be considered where product is chemically compatible with the polishing products to be used and is specifically pre-approved in writing by the polishing system Manufacturer.
3.02 EXAMINATION

A. Refer to Protection article for protection requirements.

B. Acceptance of Surfaces and Conditions: Examine substrates to be polished for compliance with requirements and other conditions affecting performance. If substrate preparation is the responsibility of another installer, notify General Contractor of unsatisfactory preparation before proceeding. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting Work within a particular area will be construed as acceptance of surface conditions.

C. Where surface cracking or other conditions requiring repairs are observed, provide additional mock-ups to review results of each proposed repair process.

D. Substrate limitations:
   1. Allow new concrete to cure a minimum of 14 days before starting initial grind.
   2. Allow new concrete to cure a minimum 45 days at 75 degrees prior to application of Polished Concrete Floor Finish. All new concrete to receive Colored Concrete Dye colors must be cured with curing methods as recommended by Manufacturer of Polished Concrete Floor System. Verify compatibility prior to application of curing.
   3. Verify that sub-floor surfaces are smooth and flat within tolerances specified in Section 03300 and are ready to receive Polished Concrete Floor Finish. Verify that the concrete floor is a minimum Flatness of 40 and Levelness of 35.
   4. Apply Polished Concrete Floor Finish minimum 15 days prior to installation of baseboard, equipment and prior to substantial completion.

3.03 SURFACE PREPARATION OF CONCRETE FLOORS

A. General:
   1. Remove curing, sealing and coating agents, floor coverings, baseboard, mastic, oil, breaking compound residue, any surface contaminants, wax and grease by mechanically or chemically removing; to remove all surface contaminants and to assure penetration of product into surface. Remove mildew by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water. All concrete surfaces receiving Polished Concrete Finish shall be properly neutralized prior to applying densifier to prevent cross contamination and whiting.
   2. Remove dust and loose material by brushing, sweeping, vacuuming, and blowing with high pressure air.
   3. Remove paint residue with solvent/stripper provided the stripper does not have an acidic pH.
   4. Remove tire marks or any residue that will affect the appearance of the floor. Do not seal in any contaminants.
   5. Power scrub and rinse entire floor surface to thoroughly rinse and remove all soap residue or contaminants. Squeegee dry.

B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, visible staining and all other foreign contaminants.

C. Surface Refinement Grout: Prepare floor by initial grinding with 80 metal grit pads. Thoroughly mix color pack, apply surface refinement grout over entire floor surface according to Manufacturer’s recommendations, and allow to cure prior to proceeding with grinding to the specified level of finish.
D. Fill joints and use joint filler and spall and crack repair materials in strict accordance with manufacturer’s guidelines. Install and coordinate in proper sequence with polishing system specified herein.

E. Treating Surface Imperfections:
   1. Prepare and clean patch areas according to Repair Material and Polishing System Manufacturers' instructions.
   2. Mix patching compound and grout material with dust created by grinding operations to match color of adjacent concrete surface (or other color match process as recommended by repair materials Manufacturer and approved by polishing system Manufacturer and Architect).
   3. Fill surface imperfections including, but not limited to, holes, surface damage, all cracks including small and surface micro cracks, air holes, pop-outs, spalls, and other voids. Perform work to match results of approved repair mock-ups.
   4. Work compound and treatment until color differences between concrete surface and filled surface imperfections are not noticeable.

F. Begin initial grinding while the concrete slab is wide open, prior to wall installation and the building is dried in. Coordinate general contractor and with other trades.
   1. If recommended by polishing system Manufacturer, pre-densify the slab prior to beginning initial grinding. Confirm recommended process with Manufacturer’s field agent.
   2. Aggregate exposure shall be kept to a minimum unless otherwise authorized and approved by Architect or Owner's Representative; Grind to 400 Grit.
   3. Complete Polished Concrete Floor Finish installation at the end of the project, nearing completion. Polish concrete floor surfaces with power disc machine; sequence with coarse grit to fine abrasive. Utilize manufacturer’s recommended equipment and polishing diamonds for installation of specified floor system using Manufacturer's seven step diamond polishing process.

G. Apply concrete dye in the correct sequence with Manufacturer’s installation instructions.

H. Fill joints and use joint filler, spall and crack repair materials in strict accordance with manufacturer’s guidelines. Install and coordinate in proper sequence with polishing system specified herein.

I. Treating Surface Imperfections:
   1. Prepare and clean patch areas according to Repair Material and Polishing System Manufacturers' instructions.
   2. Mix patching compound and grout material with dust created by grinding operations to match color of adjacent concrete surface (or other color match process as recommended by repair materials Manufacturer and approved by polishing system Manufacturer and Architect).
   3. Fill surface imperfections including, but not limited to, holes, surface damage, all cracks including small and surface micro cracks, air holes, pop-outs, spalls, and other voids. Perform work to match results of approved repair mock-ups.
   4. Work compound and treatment until color differences between concrete surface and filled surface imperfections are not noticeable.
J. Grinding: Begin initial grinding while the concrete slab is wide open, prior to wall installation and the building is dried in. Coordinate general contractor and with other trades. Aggregate exposure shall be kept to a minimum unless otherwise authorized and approved by Architect or Owner's Representative. Grind to 200 or 400 Grit as recommended by polishing system Manufacturer for best results in eliminating a varying appearance along faces of walls that typically occurs if the floor is not ground with the same, larger equipment prior to constructing walls.
   1. Protect floor from damage and soiling until grinding and polishing is resumed.
   2. Complete Polished Concrete Floor Finish installation at the end of the project, nearing completion. Polish concrete floor surfaces with power disc machine; sequence from coarser grit to fine abrasive. Utilize manufacturer's recommended equipment and polishing diamonds for installation of specified floor system using Manufacturer's seven step diamond polishing process.

K. Grout and Repair Grinding:
   1. Repair and grind concrete surfaces in proper sequence according to Polishing System Manufacturer's recommendations.
   2. Use grinding equipment and appropriate grit grinding pads, matching floor polishing system or otherwise in accordance with Polishing System Manufacturer's recommendations.
   3. While applying fresh grout material prior to final polishing, grind concrete in direction perpendicular to initial grinding as required to remove scratches and leave consistent pattern ready for final polish grinding.
   4. Vacuum floor using squeegee vacuum attachment.

L. Grind protrusions flush with surface. Patch voids, holes and cracks with recommended spall and crack repair patching compound that is compatible with sealer/hardener and Polished Concrete Floor Finish as specified herein.

M. Treating Surface Imperfections:
   1. Prepare and clean patch areas according to Repair Material and Polishing System Manufacturers' instructions.
   2. Mix patching compound and grout material with dust created by grinding operations to match color of adjacent concrete surface (or other color match process as recommended by repair materials Manufacturer and approved by polishing system Manufacturer and Architect).
   3. Fill surface imperfections including, but not limited to, holes, surface damage, all cracks including small and surface micro cracks, air holes, pop-outs, spalls, and other voids. Perform work to match results of approved repair mock-ups.
   4. Work compound and treatment until color differences between concrete surface and filled surface imperfections are not noticeable.

N. Protect surrounding and adjacent surfaces in manner recommended by Polished Concrete Stain Finish manufacturer. Do Not contaminant or Damage equipment, furniture or adjacent, surrounding surfaces with equipment, Concrete Dye stain, or Sealer/Hardener. Any damage that occurs as a result of poor workmanship shall be replaced and/or repaired by the Certified Applicator and installers.
3.04 CONCRETE POLISHING APPLICATION

A. Initial Grinding: Polished Concrete Floor Finishes shall be taken to a 400 grit prior to the walls being installed while the slab is wide open and dried in. Grind concrete to specified aggregate exposure imparting uniform scratch pattern in concrete. Vacuum floor using squeegee vacuum attachment.
   1. Deep grind / large exposed aggregate: Deep grind to achieve even level of exposure of larger aggregate across the floor surface, to desired effect as approved by mockup review.

B. General:
   1. Apply sealer/hardener and colored concrete dye with application equipment and polishing diamonds as recommended by Polished Concrete Floor Finish manufacturer for each system scheduled herein.
   2. Manufacturer’s Certified Applicator to install specified polishing system in strict accordance with manufacturer’s recommended polishing grits for each intended sequence to achieve the Polishing System, and specified level of sheen. Manufacturer's same Certified Applicator shall install concrete dye when used in conjunction with the Polishing System.
   3. Contact Manufacturer’s Technical Director or Owner’s Representative with any questions.
   4. Comply with recommendations of product manufactured for drying time between succeeding coats.
   5. Recoil dyed and sealed floors where there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat free of other defects due to insufficient sealing or dying.
   6. Remove Polished Concrete Floor Finish defects due to poor workmanship, visible and unacceptable to Manufacturer’s Representative, Architect or Owner's Representative and RE-install to achieve satisfactory results.
   7. Make edges of Polished Concrete Floor Finishes adjoining other materials clean and sharp. Make edges of Colored Concrete Dyes clean and sharp with no overlapping. Work materials and Concrete Dyes into surface voids and cracks. Detail the edges located at the base of the wall, around corners, adjacent surfaces, and all horizontal floor surfaces to match Polished Concrete Floor Finishes to provide a uniform finish to include Polished Concrete Floor Finish, color and sheen per the Approved Mock-Up.
   8. Do Not Apply Tape to Polished Concrete Finish as this will damage or etch surface and the entire system will have to be Re-Done.
   9. Begin grinding and polishing with Polished Concrete Floor Finishes Manufacturer’s recommended coarse diamond grit in uniform manner and proceed to next level of polishing diamond grit sequence to complete the Polishing System to match Approved Mock-Up for Aggregate exposure, Polished Concrete Floor Finish, Color, and Sheen.
   10. Complete all work in accordance with the Contract Documents.

C. First Coat: liquid Sealer/Hardener applied at approximately 200 SF per gallon applied to new and existing cured concrete. Applied and used in conjunction with Polished Concrete Floor Finishes. Apply by containing and flood coating surface at rates indicated, for a minimum of 60 minutes, in strict accordance with Manufacturer’s latest published instructions for each intended floor finish and surface.

D. Polishing Steps:
   1. Polish to provide indicated level of sheen and finish.
a. Level III Glossy/Polished Sheen: 1500 grit and as required to achieve uniform sheen to match approved mock-up.

2. Thin and apply as recommended by Manufacturer and apply 2 coats of RetroGuard, or Polishing System Manufacturer's equal product, allowing adequate curing time between coats.

3. Burnish each coat, heating to a minimum of 90 degrees, with high speed propane burnisher capable of 2,600 rpm’s, equipped with manufacturer’s recommended burning pads. Twister Pads shall be used to complete Polished Concrete Floor Finish using appropriate grit for each intended level of sheen specified herein.

E. Floor Protection After Polishing is Complete: Protect completed, polished floors with protective coverings, from subsequent construction activities posing risk of damage to finished floor.

1. Where construction operations that could cause physical damage to polished floors will occur after polishing operations, install protection board (whether plywood and/or hard board taped at edges) over kraft paper that is adequate to protect against damage from dropped tools, lifts, equipment, and other applicable hazards.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Manufacturer's representative to be available to provide technical assistance and guidance for surface preparation and application of floor finish system when assistance is requested. (Refer to Quality Assurance article in Part 1 of these specifications).

1. Pre-Construction Conference.
2. Field Visits as may be requested by Polishing System Applicator.
3. Quality Control Conferences to address specific issues encountered, should a conference be deemed necessary by Manufacturer's Representative, Applicator, General Contractor, Architect, or Owner's Representative.

3.06 PROTECTION

A. Protect concrete floors to be polished before initial grinding and until final polishing operations, as required to prevent grease, oil, and other contaminants that would adversely affect floor polishing results. Do not allow lifts, wheeled vehicles, or other equipment that could leak oil or other chemicals, over slabs to be polished without protection in place.

1. Install approved membrane floor protection covering continuously over concrete area to be polished according to Manufacturer's installation instructions as soon as possible after initial grinding operations are complete, but not sooner than 14 days after concrete pour, or longer where recommended by membrane protection product manufacturer or polishing system Manufacturer.

   a. In the event that the project schedule does not allow membrane installation before proceeding with other work over the slab, temporarily install untreated plywood over taped kraft paper, or other approved temporary protection measure until application of protection membrane.

2. Install plywood protection board continuously over membrane floor protection as soon as possible after protection membrane is installed. Remove and replace warped material upon building dry-in and when protection board becomes warped to the point that construction traffic over warped boards may damage protection membrane or the concrete slab.

   a. Where there is no protection membrane below plywood, install a layer of taped Kraft paper below the plywood, taped at joints.
3. Install Kraft paper with taped joints over protection membrane. Install this protection as soon as building is dried in.

4. Diaper lifts and equipment to prevent oil, gas, and contaminants from staining slab.

5. Do not use red pencil for laying out walls in areas of polished slab, or other markings that can stain the slab or leave visible lines. (Blue is generally acceptable, confirm acceptable marking materials with Manufacturer).

6. Do not use tape or other adhesive attachments to secure floor protection to unfinished concrete slab unless Concrete Floor Polishing System Manufacturer and Installer approve use of the specific tape or products to be used.

7. Should the protective membrane be inadvertently damaged, inspect for damage or spills that may have contaminated the slab. If evidence of spills are observed, immediately clean the slab as recommended by Manufacturer for best results. Install Kraft paper with taped joints over protection membrane and concrete slab in the area of damage, and replace protection boards.

8. After floor polishing operations are complete, if there is any construction activity continuing over polished floors that poses a risk of physical damage then those areas should be protected with a minimum of Masonite or hardboard taped together at the edges.

9. Maintain and modify protective covers as may be required throughout construction until removed for final polishing operations.

B. Take care to avoid physical damage to floor slab from construction operations such as dropped tools or other heavy equipment.

C. Do not allow pipe cutting, storage of steel, or sharp objects, and other materials to come into direct contact with slab that will cause discoloration or staining to slab.

1. Where pipe cutting over slab is unavoidable, provide plywood and other protection as required to prevent damage and staining of concrete surface.

D. General Contractor and Applicator shall prohibit traffic on Polished Concrete Finish (stained or non-stained) at times and durations according to Manufacturer's instructions. In each instance, Applicator shall confirm readiness of floor, including protection in place when required, before traffic is allowed to resume.

1. Provide "Wet Paint "signs as required to protect newly-polished and sealed finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of polishing operations. Barricade areas to protect Concrete Floor Polishing System (stained or non-stained) until properly cured for traffic according to Manufacturer's instructions and recommendations.

2. Protect and Cover Concrete Floor Polishing System (stained or non-stained) with materials that are recommended by Manufacturer during construction to protect from damage and debris. Do not apply Tape to the Polished Concrete finish at any time. Protect with a breathable covering such as non-marking Kraft paper or equal as recommended by the Manufacturer.

3. Protect and Cover only after Concrete Floor Polishing System (stained or non-stained) has fully cured and is ready to be covered.

E. Take extra precautions to protect Polished Concrete Floor Finish at any stage of the installation to produce the best possible results.

F. Protect finished Work with protective coverings, from subsequent construction activities posing risk of damage to finished floor.
1. Where construction operations that could cause physical damage to polished floors will occur after polishing operations, install protection board over kraft paper that is adequate to protect against damage from dropped tools, lifts, equipment, and other applicable hazards.

3.07 REPAIRS

A. Refinish all work which has become damaged or defaced during the course of construction and leave all finishing in clean, neat, and perfect condition, acceptable to the Owner’s Representative. Repair or replace all damaged materials directly attributable to work under this Section.

3.08 CLEANING AND ACCEPTANCE

A. Clean floor, and adjacent surfaces as required, prior to inspection using Manufacturer's recommended cleaners and methods.
   1. Touch-up and restore finish where damaged.
   2. Remove spilled, splashed or splattered finish material from all surfaces, as required.
   3. Do not mar surface finish or item being cleaned. Make necessary repairs to damaged surfaces caused by cleaning operation or installation of Polished Concrete Finish.
   4. Leave storage space clean and in good condition required for equivalent spaces in project.
   5. During progress of work, remove from project daily all discarded materials, rubbish, containers, etc.
   6. Do not permit the use of water or cleaning agents at any time on completed Polished Concrete Floor Finish until said period of time is acceptable to Manufacturer’s Representative and surfaces have cured for a minimum of seven (7) days, or longer where recommended by Manufacturer.
   7. Contact Polished Concrete Floor Finish Manufacturer’s Representative for detailed instructions.

B. Final acceptance of Polished Concrete Floor Finish and Sealer shall be based upon inspection by the Architect and Owner’s Representative. Polished Concrete Floor Finish and Sealer falling below specified and/or scheduled finish and approved Mock-up shall be re-done as required without additional expense to the Owner.

C. Remove temporary mockup slabs after acceptance.

END OF SECTION 03 35 36
PART 1  GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mortar for masonry.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 04 22 00 - Landscape Concrete Unit Masonry.
   3. Section 04 42 00 - Landscape Stone Assemblies.
   4. Section 32 14 40 - Stone Paving.

1.2 REFERENCES

A. ASTM International (ASTM):


1.3 SUBMITTALS

A. Submittals for Review:
   1. Samples: 1/2 x 1/2 inch x 3 inch long colored mortar samples.

B. Quality Control Submittals:
   1. Test reports: Indicating mortar compliance with ASTM C270.
   2. Delivery tickets: If mortar is delivered to site dry and pre-blended, furnish delivery tickets indicating quantity, mortar type, and date of manufacture.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with TMS 402/602.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver cement and lime in manufacturer's original, unopened packages or containers.

B. Protect materials from moisture absorption and damage; reject damaged containers.

C. Store aggregate to prevent inclusion of foreign matter.
PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Colorants:
   1. Cathay Pigments. (www.cathaypigments.com)
   2. Davis Colors. (www.daviscolors.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Portland Cement:
   1. ASTM C150, Type I.
   2. For exposed surfaces, provide cement from one source throughout project.

B. Aggregate:
   1. ASTM C144, standard masonry type.
   2. For exposed surfaces, provide aggregate from one source throughout project.

C. Lime: ASTM C207, Type S.

D. Colorant: Pure mineral oxide type.

E. Water: Clean and free from oils, acids, alkalies, organic matter, and other substances in amounts deleterious to mortar or metals in masonry.

2.3 MIXES

A. Mortar Mixes: To ASTM C270, using the Property Method.
   1. Concrete unit masonry: Type S, gray.
   2. Stone assemblies:
      a. Setting mortar: Type N, gray.
      b. Pointing mortar: Type N; refer to Materials Legend for color.

2.4 MIXING

A. Mix mortar in accordance with ASTM C270.

B. Mix using mechanical mixer. Hand mixing not permitted.

C. Mix approximately three-quarters of required water, all of cement and lime, and one-half of aggregate for minimum of 2 minutes.

D. Add remainder of water and aggregate; mix for minimum of 3 minutes.

E. Provide uniformity of color in exposed mortar.

F. Colorant may not exceed 9 pounds per 94 pound bag of cement.
G. Thoroughly mix ingredients in quantities needed for immediate use.

H. Discard lumpy, caked, frozen, and hardened mixes.

I. Mortar may be retempered by adding water as required. Use mortar within 2-1/2 hours after initial mixing at ambient temperatures below 80 degrees F and within 1-1/2 hours after initial mixing at ambient temperatures over 80 degrees F.

J. Do not add accelerators, retarders, water repellents, antifreeze compounds, or other additives without Landscape Architect's approval.

PART 3 EXECUTION

3.1 INSTALLATION

A. Follow requirements specified in referenced sections.

END OF SECTION 04 05 11
PART 1  GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Grout for masonry.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 04 22 00 - Landscape Concrete Unit Masonry.
   3. Section 04 42 00 - Landscape Stone Assemblies.

1.2 REFERENCES

A. ASTM International (ASTM):


1.3 SUBMITTALS

A. Quality Control Submittals:
   1. Test reports: Indicating grout compliance with ASTM C476.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with TMS 402/602.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver cement and lime in manufacturer's original, unopened packages or containers.

B. Protect materials from moisture absorption and damage; reject damaged containers.

C. Store aggregate to prevent inclusion of foreign matter.

PART 2  PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM C150, Type I.

B. Aggregate: ASTM C404.

C. Lime: ASTM C207, Type S.
D. Water: Clean and free from oils, acids, alkalies, organic matter, and other substances in amounts deleterious to mortar or metals in masonry.

2.2 MIXES

A. Grout Mix:
   1. ASTM C476, coarse grout.
   2. Compressive strength: Minimum 2500 psi at 28 days.
   3. Slump: 7 to 8 inches.

2.3 MIXING

A. Mix grout in accordance with ASTM C476.

B. Thoroughly mix ingredients in quantities needed for immediate use.

C. Mix dry ingredients mechanically until uniformly distributed; add water to achieve workable consistency.

D. Discard lumpy, caked, frozen, and hardened mixes.

E. Use grout within 2-1/2 hours after initial mixing at ambient temperatures below 80 degrees F and within 1-1/2 hours after initial mixing at ambient temperatures over 80 degrees F.

F. Do not add accelerators, retarders, water repellents, antifreeze compounds, or other additives without Landscape Architect's approval.

PART 3 EXECUTION

3.1 INSTALLATION

A. Follow requirements specified in referenced sections.

END OF SECTION 04 05 14
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Coordination Procedures, General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:
   1. Mortar and grout.
   2. Reinforcing steel.
   3. Masonry joint reinforcement.
   4. Ties and anchors.
   5. Embedded flashing.
   6. Miscellaneous masonry accessories.

B. Related Sections include the following:
   1. Division 04 Section - Stone Masonry.
   2. Division 05 Section - Structural Steel, for structured lintels and connections to structural steel.
   3. Division 05 Section - Metal Fabrications, for loose lintels and miscellaneous steel shapes.
   4. Division 07 Section - Bituminous Dampproofing for dampproofing applied to cavity face of backup wythes of cavity walls.
   5. Division 07 Section - Fluid Applied Membrane Air Barriers for membranes applied to exterior face of gypsum sheathing at exterior masonry cavity walls.
   6. Division 07 Section - Flashing and Sheet Metal for exposed sheet metal flashing.
   7. Division 07 Section - Joint Sealants for sealing control and expansion joints in unit masonry.

C. Products furnished, but not installed, under this Section include the following:
   1. Dovetail slots for masonry anchors, installed under Division 03 Section - Cast-in-Place Concrete.
   2. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 05 Section - Structural Steel.

D. Products installed, but not furnished, under this Section include the following:
   1. Steel lintels and shelf angles for unit masonry, furnished under Division 05 Section - Metal Fabrications.
   2. Manufactured reglets in masonry joints for metal flashing, furnished under Division 07 Section - Sheet Metal Flashing and Trim.
   3. Cast-stone trim in unit masonry.
   4. Cavity wall insulation

1.03 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing horizontal reinforcing and vertical steel reinforcing in grouted cells.
C. MCAA: Masonry Contractors Association of America

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
   3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:
   1. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
   2. Weep holes/vents.
   3. Accessories embedded in masonry.

D. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
   1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

E. Qualification Data: For testing agency.

F. Installer Qualifications: Submit evidence of contractor state license, MCAA company certification and personnel training and experience in constructing masonry structures of similar nature to this project, with a minimum of 5 years of on the job successful construction experience. List project superintendent for masonry work’s, experience, training and certifications.

G. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
   1. Masonry units.
      a. Include material test reports substantiating compliance with requirements.
      b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
   2. Cementitious materials. Include brand, type, and name of manufacturer.
   3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   4. Grout mixes. Include description of type and proportions of ingredients.
   5. Reinforcing bars.
   7. Anchors, ties, and metal accessories.

H. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
   2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
I. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

B. Applicator's Qualifications:
   1. Supervision: Maintain competent supervisor who is at Project during times specified work is in progress, and who is experienced in installing systems similar to type and scope required for Project.
   2. Experience: Company licensed in the State where the work will be performed and a MCAA certified company in good standing with not less than 5 years continuous experience under the current name in performing specified work similar in design, products, and extent to scope of this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and personnel to produce required Work.
   3. Upon request, submit list of a minimum of 5 completed projects of comparable or greater size and complexity to this Work. Include for each project:
      a. Project name and location.
      b. Name and contact information for Owner.
      c. Name and contact information of General Contractor (if applicable).
      d. Name and contact information of Architect.
      e. Date of completion.

C. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

D. Source Limitations for Mortar Materials: Obtain mortar ingredients for each type exposed unpainted masonry of a uniform quality, including color, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

E. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
   1. Prism Test: For each type of construction required, per ASTM C 1314.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section - Project Management and Coordination.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.07 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
   2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.


F. Coordination: Advise installers of other work about specific requirements for placement of flashing and similar items to be built into stone masonry. Coordinate electrical devices and other items built into stone masonry.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.02 MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout.
Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.03 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color cement with pigments as required to produce mortar color indicated:
1. As selected by Architect from full range of available colors.
2. As selected by Architect from full range of available colors at stone masonry veneer locations.
3. Low-Alkali Cement: Where recommended by stone source to limit staining, provide low-alkali cement, not more than 0.06 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Davis Colors; True Tone Mortar Colors.
   b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
   c. Solomon Colors, Inc.; SGS Mortar Colors.

D. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs only, containing integral water repellent by same manufacturer.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. ACM Chemistries, Inc.; RainBloc for Mortar.
   b. BASF; MasterPel 240 Mortar Admixture.

E. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

F. Aggregate for Grout: ASTM C 404.

G. Cold-Weather Admixtures: Admixtures for stone masonry shall only be used if approved by stone source and Architect for use with the specific stone specified. If approved, all mortar throughout the stone work shall incorporate the admixture at the same rate, as required to maintain consistent color.

2.04 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Stainless Steel Type 304.
5. Wire Size for Veneer Ties: 0.187-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods, unless otherwise noted in Structural Drawings or Specifications.

D. Masonry Joint Reinforcement for Multiwythe Masonry:
   1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe unless otherwise noted in Structural Drawings or specifications, and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
   2. Available products:
      a. Dur-O-Wall; Truss design DA3700 Dur-O-Eye.
      b. Wire-Bond; Series 900 Level Hook and Eye Truss.

2.05 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with subparagraphs below, unless otherwise indicated.
   1. Stainless Steel, Type 304, ASTM A580/ASTM 580M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
   1. Connector Section for Concrete: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.053-inch-thick, steel sheet, galvanized after fabrication.

D. Adjustable Masonry-Veneer Anchors at wood studs
   1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
      a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
   2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
      a. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, and having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.
      b. Fabricate sheet metal anchor sections and other sheet metal parts from 0.067-inch-thick, Stainless Steel, Type 304, ASTM A580/ASTM 580M.
      c. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.188-inch-diameter, Stainless Steel, Type 304, ASTM A580/ASTM 580M.
      d. Available Products: Basis of Design Product:
         1) For Coursed Masonry: Hohmann & Barnard, Inc.
            a) HB-213-Adjustable Veneer Anchor
            b) Provide with membrane flashing tape at air barrier, provided and installed under Division 07 “Air Barrier” Section(s), or: Hohmann & Barnard, Inc. X-Seal Tape may be substituted if allowed by air barrier manufacturer.
2.06 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing (Copper Composite): For flashing not exposed to the exterior, use the following, unless otherwise indicated:

   a. Product:
      1) York Manufacturing, Inc.; York Copper Fabric Flashing, “Multi-Flash 500”.
      2) STS Coatings, Inc.; Wall Guardian Copper TWF
      3) Wire-Bond, Inc.; Copper Seal

2. Copper Laminated Flashing shall not be used for any flashings that will be exposed to view in the completed work. Refer to Division 07 Section “Sheet Metal Flashing and Trim” for material type(s) for embedded flashings that are exposed to view or partially exposed to view. General Contractor shall coordinate responsibility to provide and install other flashing types.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

   1. One part 100% solids, solvent-free formulated silyl-terminated polyether (STPE), ASTM C920-11, Type S, Grade NS, Class 50, York “Universeal US100” or equivalent.

C. Termination bars: Provide stainless steel termination bars in cavity walls where copper flashing will be installed with termination bars to concrete block backup and with waterproof sealant to protect top side of terminations refer to Division 07 section on “Sealant”.

   1. Do not use termination bars at face of sheathing unless specifically detailed otherwise in the Drawings. Through-wall flashings at stud construction shall extend through and turn up behind exterior sheathing and ci insulation. Air barrier system materials (per Division 07 Air Barrier Sections) shall lap over and down the face of the through-wall flashings.
   2. Termination Bars for Flexible Flashing: #304 Stainless steel sheet 0.090 inch by 3/4 inches minimum with a 3/16 inch minimum sealant flange at top, 8 inch oc pre-punched bolt holes minimum.
   3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. OMG Roofing Products
      b. Hohmann & Barnard, Inc. (T1 with Foam-Tite option)
      c. Wire-Bond.

2.07 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

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

D. Weep/Vent Products:

   1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
      a. Available Products:
1) Advanced Building Products Inc.; Mortar Maze weep vent.
2) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
3) Heckmann Building Products Inc.; No. 85 Cell Vent.
4) Hohmann & Barnard, Inc.; Quadro-Vent.
5) Wire-Bond; Cell Vent.

b. Colors: As selected by architect, to minimize appearance for each color of mortar or exposed masonry condition.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Provide one of the following configurations:
   a. Strips, full-depth of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings.
   b. Strips, not less than 1-1/2 inches thick and 10 inches wide, with dimpled surface designed to catch mortar droppings and prevent weep holes from being clogged with mortar.

2. Available Products:
   a. Advanced Building Products Inc.; Mortar Break II.
   b. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
   c. Mortar Net USA, Ltd.; Mortar Net.

F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.

1. Available Products:
   a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
   c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
   d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2. In event of conflict with reinforcing bar positions required in Structural Drawings, provide type indicated in Structural Drawings.

2.08 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned. The use of muriatic acid is prohibited.

1. Available Manufacturers:
   a. Diedrich Technologies, Inc.
   b. EaCo Chem, Inc.
   c. ProSoCo, Inc.

2. Do not use materials or methods that can damage masonry finishes. Use only manufacturer's approved products and methods.

2.09 MORTAR AND GROUT MIXES

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

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

B. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
   1. For masonry below grade or in contact with earth, use Type S.
   2. For reinforced masonry, use Type S.
   3. For mortar parge coats, use Type S.
   4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

C. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
   2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

2.10 SOURCE QUALITY CONTROL
A. Owner will engage a qualified independent testing agency to perform source quality-control testing indicated below:
   1. Payment for these services will be made by Owner.
   2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

B. Concrete Masonry Unit Test: For each type of unit furnished, per ASTM C 140.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

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

3.02 COORDINATION
A. Contractor is responsible to coordinate between trades prior to concrete slab pours to avoid conflicts with CMU wall construction, including but not limited to the following:
   1. Positions, sizes, and other requirements for locating all reinforcing coming up through slab. Unless otherwise noted in Structural Drawings, post-installation with epoxy anchors is not an equivalent method of installation. Any request to substitute post-installed anchors in masonry construction should be pre-approved by Contractor via RFI to the Structural Engineer of record, and the Structural Engineer may reject requests for such substitution.
   2. Coordinate all conduits and pipes as shown on MEP drawings for concealed installation.
3. Reinforced / grouted cells will not be in conflict with electrical conduits, plumbing pipes, or other items built into CMU cells. This includes the quantity, sizes, and locations to comply with all notes, specific location details, and typical details, as indicated in the Structural Drawings.
   a. A large number of conduits in a line could cause non-compliance with Structural requirements, either for the CMU wall, or in the concrete slab. In areas where many conduits are required for electrical items, request clarification from Architect and Structural Engineer as to allowable routings of conduits to avoid adverse impact on the structural system.

4. Confirm sill sealer gaskets are installed where studs meet concrete slabs, prior to beginning veneer installation.

3.03 INSTALLATION, GENERAL
A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed. Do not install any cut units at corner conditions.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

F. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
   1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
   5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
   6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
   7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.04 MORTAR BEDDING AND JOINTING
A. Lay hollow brick and concrete masonry units as follows:
   1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Mortar joints to be tooled (concave), except special joints as detailed.

3.05 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:
1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 1.77 sq. ft. of wall area spaced not to exceed 16 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
   a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
   b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.
   a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
   b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement.
   c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement to allow for differential movement regardless of whether bed joints align.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Coat cavity face of backup wythe to comply with Division 07 Section - Bituminous Dampproofing. Where indicated on drawings.

D. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
   1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

E. Membrane Dampproofing: Re: Division 07

3.06 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing or concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
3. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of insulation.
4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
5. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
6. Provide self-sealing tape to seal around shaft of screw and legs of anchor at the point of penetration. Unless otherwise indicated in Division 07 “Air Barrier” sections, tape may be applied at each anchor or in continuous vertical strips, however continuous strips are highly recommended where exterior insulation will visually obscure the tape locations at the air barrier.

3.07 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows using one of the following methods:
   1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
   2. Install preformed control-joint gaskets designed to fit standard sash block.
   3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
   4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Location of expansion joints:
   1. At long walls no greater than 25 feet maximum.
   2. At offsets in walls.
   3. Near corners (10 ft. maximum).
   4. At intersections of walls.
   5. Where short runs of masonry intersect long runs of masonry.
   6. Where materials of different coefficients of thermal expansion are joined.

D. Form open joint full depth of brick wythe and of width indicated, but not less Provide horizontal, pressure-relieving joints by inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section - Joint Sealants, but not less than 3/8 inch.
   1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.08 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.09 FLASHING, WEEPS, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weeps in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at 2'-0" on center at top of masonry walls shelf angles, lintels, and other obstructions to upward flow of air in cavities, and where indicated. Embed flashing in manufacturer’s recommended sealant. Seal lap joints as recommended by manufacturer.

B. Install flashing as follows, unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
   2. At multi wythe masonry walls, including cavity walls, extend flashing through outer wythe, across air space behind veneer, behind ci insulation and turned up face of bituminous coated masonry inner wythe a minimum of 8 inches. Secure to the inner wythe with continuous termination bar. Seal top of termination bar and install ci insulation over flashing.
   3. At stud-framed walls with masonry-veneer walls, extend flashing through veneer, across air space behind veneer, up face of sheathing at least 8 inches, through sheathing and up back of sheathing a minimum of 4 inches. Install ci insulation and water/vapor barrier over flashing.
   4. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends, turn up and fold not less than 2 inches to create a folded end dam, per manufacturers recommendations & literature.
   5. Cut flexible flashing off flush with face of wall after masonry wall construction is completed and reviewed by architect.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weeps in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
   1. Use specified weep/vent products to form weeps.
   2. Form weeps above flashing under brick sills.
   3. Space weeps 24 inches o.c., unless otherwise indicated.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article. At a minimum, place Mortar Net to a height equal to the height of the first course, but not less than 8 inches. Place immediately above the top of flashings embedded in the wall, as masonry construction progresses, to catch mortar droppings and to maintain drainage.

F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.
   1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

G. Install sill sealer at sill plate per manufacturer's written instructions.

3.10 REINFORCED UNIT MASONRY INSTALLATION

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

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

E. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.

F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

G. Prism Test: For each type of construction provided, according to ASTM C1314 at 7 days and at 28 days.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.

4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.


6. Where required clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION 04 81 00
SECTION 04 22 00 - LANDSCAPE CONCRETE UNIT MASONRY

PART 1  GENERAL

1.1  SUMMARY

A.  Section Includes:
   1. Landscape concrete unit masonry.

B.  Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 04 05 11 - Landscape Masonry Mortaring.
   3. Section 04 05 14 - Landscape Masonry Grouting.

1.2  REFERENCES

A.  ASTM International (ASTM):
   1. A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete
      Reinforcement.
   3. C90 - Standard Specification for Hollow Loadbearing Concrete Masonry Units.

B.  The Masonry Society (TMS) 402/602 - Building Code Requirements and Specifications for Masonry
    Structures.

1.3  SUBMITTALS

A.  Submittals for Review:
   1. Product Data: Provide information on reinforcing including sizes, profiles, materials, and
      finishes.

1.4  QUALITY ASSURANCE

A.  Installer Qualifications: Minimum 2 years experience in work of this Section.

B.  Perform Work in accordance with TMS 402/602.

1.5  DELIVERY, STORAGE AND HANDLING

A.  Protect reinforcement from corrosion.

1.6  PROJECT CONDITIONS

A.  Wall Protection:
   1. During erection, cover tops of partially completed walls with strong waterproof membrane at
      end of each day or work stoppage.
   2. Extend cover minimum of 24 inches down both sides; hold securely in place.

B.  Load Application:
   1. Do not apply uniform loads for at least 12 hours after building masonry walls.
   2. Do not apply concentrated loads for at least 3 days after building masonry walls.
C. Environmental Requirements:
   1. Hot weather requirements: If ambient temperature is over 95 degrees F or relative humidity is less than 50 percent, protect from direct sun and wind exposure for minimum 48 hours after installation.
   2. Cold weather requirements: Do not use frozen materials or build on frozen work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Masonry Accessories:
   1. Blok-Lok Ltd. (www.blok-loc.com)
   2. Dur-O-Wal. (www.dur-o-wal.com)
   3. Heckmann Building Products. (www.heckmannbuildingprods.com)
   4. Hohmann and Barnard, Inc. (www.h-b.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Concrete Masonry Units:
   1. ASTM C90, hollow load bearing type, light weight.
   2. Size: Nominally 8 inches high x 16 inches long x thickness indicated.

2.3 ACCESSORIES

A. Mortar: Specified in Section 04 05 11.

B. Grout: Specified in Section 04 05 14.

C. Joint Reinforcement:
   1. Ladder type; ASTM A951, hot-dip galvanized steel wire, 9 gage side rods with 9 gage cross ties.
   2. Width: Nominal wall thickness less 1-1/2 inches.
   3. Corner and tee fittings: Type to match reinforcement.

D. Reinforcing Bars: ASTM A615/A615M, deformed billet steel, Grade 40 or 60.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove dirt, loose rust, and other foreign matter from reinforcement.

3.2 INSTALLATION

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

B. Maintain masonry courses to uniform dimensions. Form horizontal and vertical joints of uniform thickness.
C. Lay concrete masonry in running bond. Course one masonry unit and one mortar joint to equal 8 inches.

D. Lay masonry plumb and level. Do not adjust masonry units after mortar has set.

E. Lay masonry units with face shell bedding on head and bed joints.

F. Do not butter corners or excessively furrow joints.

G. Machine cut masonry with straight cuts and clean edges; prevent oversized or undersized joints. Discard damaged units. Do not expose cut cells.

H. When joining fresh masonry to partially set masonry, remove loose masonry and mortar; clean and lightly wet exposed surface of set masonry.

I. Stop horizontal runs by racking back normal bond unit in each course. Toothing not permitted.

J. Horizontal Reinforcement:
   1. Place reinforcement at maximum 16 inches on center vertically and at topmost course.
   2. Extend minimum 24 inches each side of openings.
   3. Center reinforcing in wall.
   4. Lap ends 6 inches minimum; use fabricated tee and corner fittings at corners and intersections.

K. Control Joints:
   1. Do not continue horizontal joint reinforcement through joints.
   2. Keep joints free from mortar and grout.

L. Finishing Mortar Joints:
   1. Exposed locations: Tool joints to concave profile.
   2. Concealed locations: Cut joints flush.

M. Reinforcing Bars:
   1. Position reinforcing accurately and hold securely in place to prevent displacement. Maintain minimum 1 inch space between masonry and reinforcing.
   2. Grout at intervals of not more than 60 inches in 6 to 8 inch lifts.
   3. Vibrate grout during and after placement to ensure complete filling.
   4. Stop grout 1-1/2 inch below top of masonry if grouting is stopped for 1 hour or more, except where completing grouting of finished wall.

N. Installation Tolerances; Maximum variation from:
   1. Alignment face to face of adjacent units: Plus or minus 1/8 inch.
   2. Vertical alignment of head joints: Plus or minus 1/2 inch in 10 feet.
   3. True plane of wall: Plus or minus 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
   4. Plumb: Plus or minus 1/4 inch in 10 feet noncumulative; 1/2 inch in 20 feet or more.
   5. Level coursing: Plus or minus 1/8 inch in 3 feet; 1/4 inch in 10 feet; 1/2 inch in 30 feet.

END OF SECTION 04 22 00
PART 1  GENERAL

1.1  SUMMARY

A. Section Includes:
   1. Natural stone assemblies.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 04 05 11 - Landscape Masonry Mortaring.
   3. Section 04 05 14 - Landscape Masonry Grouting.
   4. Section 07 92 05 - Landscape Joint Sealers.

1.2  REFERENCES

A. ASTM International (ASTM):


1.3  SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Include location and sizes of pieces, arrangement and size of joints, anchorage details, and other details of installation.
   2. Product Data: Provide information on anchors including sizes, profiles, materials, and finishes.
   3. Samples: 12 x 12 inch stone samples showing each color and surface texture.

1.4  QUALITY ASSURANCE

A. Fabricator and Installer Qualifications: Minimum 3 years experience in work of this Section.

B. Obtain each stone from a single quarry and from the same area within the quarry.

C. Mockup:
   1. Size: 4 feet high x 4 feet wide.
   2. Show:
      a. Stone color and texture ranges.
      b. Mortar joint size, color, and profile.
      c. Bond pattern.
      d. Anchors.
   3. Locate where directed.
   4. Approved mockup may remain as part of the Work.

D. Perform Work in accordance with TMS 402/602.
1.5 DELIVERY, STORAGE AND HANDLING
   A. Store stone off ground; prevent contact with materials that could cause staining or damage.
   B. Protect anchors from corrosion.

1.6 PROJECT CONDITIONS
   A. Environmental Requirements:
      1. Do not install stone when surrounding air or substrate surface temperature is below 40 degrees F or above 90 degrees F during or 48 hours after completion of the work.
      2. Do not install stone when wind velocity exceeds 15 MPH or relative humidity exceeds 70 percent.
      3. At end of working day and during rainy weather, cover work exposed to weather with waterproof coverings, securely anchored.

PART 2 PRODUCTS

2.1 MANUFACTURERS
   A. Acceptable Manufacturers - Masonry Accessories:
      1. Blok-Lok Ltd. (www.blok-lok.com)
      2. Dur-O-Wal. (www.dur-o-wal.com)
      3. Heckmann Building Products. (www.heckmannbuildingprods.com)
      4. Hohmann and Barnard, Inc. (www.h-b.com)
   B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS
   A. Stone:
      1. Type, size, color, and surface finish: Refer to Materials Legend.
      2. Free from defects that could impair its structural integrity or function. Inherent variations characteristic to quarry from which it is obtained are acceptable.

2.3 ACCESSORIES
   A. Mortar: Specified in Section 04 05 11.
   B. Grout: Specified in Section 04 05 14.
   C. Veneer Ties: Wire mesh, 1/4 inch x 23 gage, hot dip galvanized, ASTM A153/A153M, 4 x 8 inches.
   D. Fasteners: Hot-dip galvanized steel, minimum 3/4 inch penetration into substrate.
   E. Cleaner: Type recommended by stone supplier.
   F. Joint Sealers: Specified in Section 07 92 05.

2.4 FABRICATION
   A. Fabricate stone for uniform coloration between adjacent units and over full area of installation.
B. Form external stone corners to square butt joint profile. Clean jagged corners from stone in preparation for setting.

C. Fabricate for 3/8 inch beds and joints.

D. Cut or saw bed and joint surfaces square for full thickness of unit.

E. Backs: Sawn.

F. Slope exposed top surfaces of stone and horizontal sill surfaces for shedding water.

G. Cut drip slot in stone projecting more than 1 inch. Size slot not less than 1/4 inch wide and deep for full width of projection.

H. Fabrication Tolerances:
   1. Variation in width or height: Plus or minus 1/16 inch.
   2. Variation in thickness: Plus or minus 1/8 inch.
   3. Variation from true plane: Plus or minus 1/16 inch in 3 feet.

PART 3 EXECUTION

3.1 PREPARATION

A. Establish lines, levels, and coursing. Protect from disturbance.

B. Clean stone prior to installation. Do not use wire brushes or implements that can mark or damage exposed surfaces.

C. Wet absorptive stone in preparation for placement to minimize moisture suction from mortar.

3.2 INSTALLATION

A. Arrange stone pattern to provide color uniformity and constant 3/8 inch joint sizes throughout.

B. Set stone plumb and level. Align adjacent pieces in same plane.

C. Set stone in full mortar setting bed; support stone over full bearing surface.

D. Set stone to bond pattern indicated.

E. Completely fill beds and joints, then rake out for pointing.

F. Fill joints with pointing mortar; tool to indicated profile.

G. Veneer Ties:
   1. Space ties to provide one tie per 2 square feet at maximum spacing of 16 inches on center horizontally.
   2. Locate ties within 3 inches of ends of masonry walls and openings.

H. Fill void space between stone veneer and concrete backup with grout placed in maximum 8 inch high lifts. Rod or vibrate to consolidate.
I. Control Joints:
   1. Keep joints free from mortar and grout.
   2. Install joint backing and joint sealer as specified in Section 079205.

J. Installation Tolerances; Maximum variation from:
   1. Alignment face to face of adjacent units: Plus or minus 1/8 inch.
   2. Vertical alignment of head joints: Plus or minus 1/2 inch in 10 feet.
   3. True plane of wall: Plus or minus 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
   4. Plumb: Plus or minus 1/4 inch in 10 feet noncumulative; 1/2 inch in 20 feet or more.
   5. Level coursing: Plus or minus 1/8 inch in 3 feet; 1/4 inch in 10 feet; 1/2 inch in 30 feet.
   7. Cross sectional thickness of walls: Plus or minus 1/4 inch.

3.3 CLEANING

A. Clean stone with detergent and water applied with fiber brush.

B. If initial cleaning does not produce acceptable results, apply cleaner in accordance with manufacturer's instructions.
   1. Protect adjacent and underlying surfaces and plant materials.
   2. Thoroughly rinse surfaces with clean water after completion of cleaning; remove all traces of cleaning solution.

3.4 PROTECTION

A. Protect stone subject to damage by use of nonstaining sheet coverings.

END OF SECTION 04 42 00
SECTION 04 43 00 - STONE MASONRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Provide stone exterior wall material, laid up like masonry, as shown on the Drawings and as specified herein.

B. Related Sections include the following:
   1. Division 04 Section - Unit Masonry Assemblies
   2. Division 06 Section - Rough Carpentry
   3. Division 07 Section - Sheet Metal Flashing and Trim.
   4. Division 07 Section - Joint Sealants.

1.03 SUBMITTALS

A. Submit shop drawings per requirements of Division 01 Section, showing layout and details of construction, anchors, jointing and setting.

B. Submit two 18” x 18” samples of each type of finish of stone specified, showing full range of colors and mix as specified, for approval by Architect.

C. Copies of complete data on stone fabricator. Architect reserves the right to reject the fabricator if adequate past experience in the production of the types of units specified is not assured by the data submitted.

D. Copies of supplier’s specifications and test data for type of stone required, including certification that stone complies with the specified requirements. Include instructions for handling, storage, installation and protection of stone.

E. Copies of complete data showing all colors, textures and finishes available.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store materials in a dry place, above ground on level platforms. Cover and protect units as necessary from elements.

1.05 JOB CONDITIONS

A. Coordinate stonework with other trades whose work relates to this section, in any manner, for placing of all required backing, blocking and leave-outs, etc. Advise installers of adjacent Work about specific requirements for placement of reinforcement, veneer anchors, flashing, and similar items to be built into stone masonry. Coordinate locations of dovetail slots installed in concrete that are to receive stone anchors.

B. Masonry work shall not be placed when there is any possibility of the water freezing before it has attained its initial set. In weather below freezing, all masonry units and mortar shall be heated. Walls which have frozen after making their initial set shall not be built upon until they have had sufficient time to make a proper set at temperatures above freezing.
C. All newly placed masonry shall be protected against damage from action of the elements and under no condition shall rain be allowed to fall on, drive against or flow down masonry surfaces until mortar has set a minimum of 12 hours. Tops of all walls shall be covered with a waterproof material at the end of each day.

D. All newly placed stone shall be protected from damage of any sort.

1.06 QUALITY ASSURANCE

A. Qualification of fabricator: Obtain each stone from single quarry source, with accepted color range and texture throughout the work as established by approved samples.

B. Sources or kinds of materials as approved shall not be changed during course of work.

C. Stone fabricator shall have successfully fabricated work similar to quality specified in quantity shown for period of not less than 5 years.

D. Stone fabricator shall have been engaged in the business of fabricating stone specified for a period of not less than (5) years. Provide reference including project name, project architect and General Contractor.

E. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters, with at least 5 years’ documented experience in installing stone masonry of the type, scope, and complexity as required for this project.

F. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. ASTM C 97, Absorption and Bulk Specific Gravity of Natural Building Stone
   2. ASTM C 99, Modulus of Rupture of Natural Building Stone
   3. ASTM C 170, Compressive Strength of Natural Building Stone.

G. Pre-Installation Meeting: Convene a pre-installation meeting at least one week prior to commencing Work of this Section.

H. Mock-Ups: Build 4’ x 4’ mock-ups for stone masonry to comply with mockup requirements as specified in Division 04, Section “Unit Masonry Assemblies”.
   1. Build mockup as shown on drawings, including face and backup wythes, fenestrations, flashings and accessories.
      a. Prior to product installation a field-constructed mock-up shall be provided under the provisions of Division 1 Section - Submittals, Product Data, Samples and Mock-ups, to verify details & tie-ins, and to demonstrate the required quality of materials and installation.
      b. Construct a typical exterior wall section, incorporating back-up wall, cladding, window and sill, insulation, flashing and any other critical junctions (roof, foundation, etc.) as detailed in Drawings at typical wall locations as located by Architect.
      c. Build mockups as indicated in Drawings.
         1) Show typical components, attachments to building structure, and methods of installation.
      d. Obtain Architect's approval of mockups before starting installation.
      e. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
      f. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.

Demolish and remove mockups when directed.

1.07 DELIVERY, STORAGE & HANDLING

A. Delivery of Materials:
1. Carefully pack and unload stone with necessary caution to avoid damaging or soiling stone.
2. Deliver stone in original package or pallets, plainly marked with identification of materials and manufacturer.

B. Storage of Materials:
1. Store stone clear of the ground on non-staining skids made of non-chemically treated wood or of wood not containing tannin.
2. Cover stone on all sides and bottom with waterproof paper, clean canvas or polyethylene.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All stone shall be standard grade, free from cracks, seams or other imperfections which might impair its structural integrity and finish. All stone furnished must conform to and be within the range of approved samples. Cut accurately to shape and dimensions shown on final shop drawings. Variations on surfaces from true plane shall not exceed 1/8” for smooth finish.

B. Basis of Design, alternate stone quarry acceptable per approval by Owner and Architect.
1. Stone:
   a. Color, texture and finish within range of samples approved by Architect.
   b. Limestone:
      1) Source: “Bowie Blend” by Blackson Stone Quarries., Dallas, Texas
         Contact: Bart Snowden, (214) 794-9159
         (214) 747-2636
      2) Sizes:
         1) Sawn Heights: 4”, 6”, 8” tall
         2) Window Head – Sawn smooth all sides 10” tall x 24” long x 4-5/8” thick
         3) Window Sill – Sawn Smooth all sides – 4” tall x 24” long x 8-5/8” thick with 1” x 7” slope and a drip cut
      d. Thickness: Nominal 3-1/2” to 5-1/2” rough faced stone complying with ASTM C 568, Category II (medium density)
   c. Minimum compression strength 4000 psi per ASTM C170 and maximum absorption 7.5% per ASTM C 97

2.02 ACCESSORIES

A. Anchors:
1. Refer to Division 04, Section “Unit Masonry Assemblies”.
2. Stone Trim Anchors: Units fabricated with tabs or dowels designed to engage kerfs or holes in stone trim units and holes for fasteners or post-installed anchor bolts for fastening to substrates or framing as indicated. Fabricate from ASTM A 241, Type 304 stainless steel, with annealed stainless steel bolts, nuts and washers.

B. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

C. Spacers: Impact resistant plastic (1/4” max. thickness)
D. Embedded Flashings: Refer to Division 04, Section “Unit Masonry Assemblies” for concealed flashings, and Division 07, Section “Sheet Metal Flashing and Trim” or Division 08 Section “Aluminum Storefront” as applicable for exposed flashings.

E. Joint Sealers: Specified in Division 07 Section.

F. Cleaning Solution: type that will not harm stone, joint material, or adjacent surfaces.

G. Mortar Mixes, vents, weeps, cavity drainage material, and other accessories as required for complete installation: Refer to Division 04, Section “Unit Masonry Assemblies”.

2.03 FABRICATION

A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.

B. Cut stone to produce pieces of thickness, size, and shape indicated, including details on Drawings and coursing pattern specified.

C. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.

D. Cut and drill kerfs, sinkages and holes in stone for anchors and supports, where applicable.

E. Carefully inspect stone at quarry or fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units before shipment.
   1. Clean sawed backs of stone to remove rust stains and iron particles

F. Fabricate stone with all sides showing saw lines or marks to be concealed in the finished work.

G. Thickness of Stone: Provide thickness indicated, but not less than the following:
   1. Thickness: Nominal 4 inches, plus or minus 1 inch on chopped stone.

H. Anchorage:
   1. Space anchors at maximum 24 inches on center and around perimeter.
   2. Minimum number of anchors: four per panel.

I. Fabrication Tolerances
   1. Variation in width or height: plus or minus 1/8 inch
   2. Variation in thickness: plus or minus 1/8 inch
   3. Variation in form true plane: plus or minus 1/16 inch in 3 feet

J. Finish exposed stone faces and edges to comply with requirements indicated for finish and to match approved samples and mockups.
   1. Fabricate stone with natural finish on all exposed faces and edges. Do not expose sawed faces in completed work.
   2. Provide random return length on all outside corners to approximate the look of structural stone masonry.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect foundations to assure surfaces to support masonry are to proper grades and elevations, free of dirt or uneven surfaces. Examine all subsurfaces to receive stone work. Report in writing to General Contractor, with a copy to Architect, any conditions which may prove detrimental to the work. Examine wall framing, sheathing, and weather-resistant sheathing paper to verify that stud locations are suitable for spacing of veneer anchors and that
installation will result in a weatherproof covering. Commencement of work will be construed as acceptance of all subsurfaces.

B. Inspect to ensure that air barrier systems are sound, continuous, and undamaged prior to commencing work. Do not install stone work over damaged air barrier systems, including those damaged by stone work installation. Make repairs before proceeding.

3.02 PREPARATION

A. Establish lines, levels and coursing. Protect from disturbance.

B. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

C. Ensure that stud centerlines are accurately marked on face of continuous insulation before beginning stone installation.

D. Confirm with General Contractor, and with mechanical, electrical, security systems, and other trades as required the complete list of penetrations, electrical boxes, door bells, cameras, and other equipment and items that are required to be built into stone veneer. Confirm the location of each item to accurately locate it in coordination with stone work.

E. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.

F. Wet absorptive stone in preparation for placement to minimize moisture suction from mortar.

3.03 STONE INSTALLATION

A. Install supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place. All anchors shall be concealed.

B. Coordinate with other trades for placement of inserts and anchors. Provide templates or drawings as required.

C. Arrange stone pattern to provide color uniformity and constant joint sizes throughout, and for an evenly blended appearance and to match effect of approved mockups.

D. Coat limestone with cementitious dampproofing as follows:
   1. Stone at Grade: Beds, joints, and back surfaces to at least 12 inches above finish-grade elevations.
   2. Stone Extending below Grade: Beds, joints, back surfaces, and face surfaces below grade.
   3. Allow cementitious dampproofing formulations to cure before setting dampproofed stone. Do not damage or remove dampproofing in the course of handling and setting stone.

E. Set stone plumb and level. Align adjacent pieces in same plane.

F. Execute work with skilled mechanics and employ skilled fitters at site to do necessary field cutting as stone is set.

G. Provide openings and other spaces as shown or required for contiguous work. Close up openings in stone after other work is in place. Use materials and set to match surrounding work.

H. Install steel lintels where indicated. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

I. Set stone in accordance with final shop drawings.
J. Have all work done by competent stone masons and to appearance approved by Architect.
K. Remove and replace damaged or defective stonework to match adjacent acceptable stonework.
L. Construction Tolerances:
   1. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.
   2. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.
   3. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet or 3/4 inch in 40 feet or more.
   4. Measure variation from level, plumb, and position shown in plan as a variation of the average plane of each stone face from level, plumb, or dimensioned plane.
   5. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.
   6. Variation in Plane between Adjacent Stones: Do not exceed one-half of tolerance specified for thickness of stone.

3.04 FLASHINGS AND WEEP HOLES
A. Install in compliance with Division 04, Section “Unit Masonry Assemblies”, and the following:
B. All flashings installed in accordance with herein specified requirements and in accordance with manufacturer's recommendations so that all flashing work properly drains water to the outside.
C. Provide smooth mortar beds, slightly pitched to the outside face of the wall at all points where flashings are to be installed over horizontal surfaces.
D. Flashing shall extend beyond outside face of wall as detailed on drawings.
E. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends, turn up and fold not less than 2 inches to create a folded end dam, per manufacturers recommendations & literature
F. Install weep vents in vertical joint of first course above flashings at 24” o.c.
G. Install vents at 48” o.c. at top of wall, and other obstructions to upward flow of air.
H. Flashing to be installed with top edge extending behind sheathing as detailed on drawings.

3.05 CONTROL & SOFT JOINTS
A. Make adequate provisions throughout the stone work for expansion and contraction. Install preformed control joint gasket, extending from top of bearing surface to top of wall, reinforcing shall not run through.
B. Install soft joint material at top of stone.

3.06 SEALED JOINTS
A. Outside joints at the perimeter of exterior door and window frames shall not be less than 1/4" nor more than 3/8" wide and shall be cleaned out to a uniform depth of at least 3/4" for sealant, provided under Division 07 Section.
3.07 BUILT-IN WORK
   A. Contractor shall carefully examine architectural and mechanical drawings providing all slots, chases, recesses in masonry work, and coordination of items to be built into masonry veneer as required. No pipes shall be enclosed before they are tested.

3.08 INSTALLATION TOLERANCES
   A. Maximum variation from level and plumb: 1/8 inch in 10 feet, noncumulative.
   B. Maximum variation in plane between adjacent pieces as joint: Plus or minus 1/16 inch.

3.09 CLEANING
   A. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.
   B. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:
      1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
      2. Test cleaning methods on mockup.
      3. Follow all direction for approved masonry cleaner.
   C. If initial cleaning does not produce acceptable results, apply cleaner in accordance with manufacturer’s instructions
      1. Prior to applying, clean sample panel in area as directed by Architect. If approved, use same materials and techniques for cleaning remainder of stone.
      2. Protect adjacent surfaces.
      3. Wet stone prior to applying cleaner.
      4. Thoroughly rinse surfaces with water after completion of cleaning: remove all traces of cleaning solution.
   D. Remove and replace stone masonry of the following description:
      1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
      2. Defective joints.
      3. Stone masonry not matching approved samples and mockups.
      4. Stone masonry not complying with other requirements indicated.
   E. Replace defective work in a manner that results in stone masonry matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

3.10 PROTECTION
   A. Protect stonework from soiling and damage during all phases of construction.

3.11 EXCESS MATERIALS AND WASTE
   A. Excess Stone: Offer excess stone (if any) for Owner’s use or future repairs. Stack excess stone to quantity to be retained by Owner where directed by Owner for Owner's use, and remove the remainder from the project site.
   B. Excess Masonry Waste: Remove excess masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 43 00
PART 1  GENERAL

1.1  SUMMARY

A.  Section Includes:
   1.  Collected stone boulders.

B.  Related Sections:
   1.  Division 01: Administrative, procedural, and temporary work requirements.

1.2  REFERENCES

A.  ASTM International (ASTM)D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft$^3$) (600 kN-m/m$^3$).

1.3  QUALITY ASSURANCE

A.  Mockups:
   1.  Size: One typical boulder of each size.
   2.  Show: Stone size, color, and texture.
   3.  Locate where directed.
   4.  Approved mockups may remain as part of the Work.

PART 2  PRODUCTS

2.1  MATERIALS

A.  Collected Stone Boulders:
   1.  Existing boulders salvaged during onsite excavation operations.
   2.  Clean stone using high pressure water; remove soil and foreign matter without damage to stone.
   3.  Store boulders off ground after cleaning; protect from damage.

PART 3  EXECUTION

3.1  PREPARATION

A.  Compact soil to receive stones to minimum 95 percent of ASTM D698 standard proctor density at or near optimum moisture content.

3.2  INSTALLATION

A.  Orient boulders for best appearance.

B.  Place boulders on solid bearing.

C.  Obtain Landscape Architect's approval of location and appearance.
3.3 CLEANING
   A. Clean stone after installation using stiff brushes and water.

3.4 PROTECTION
   A. Protect stone subject to damage by use of nonstaining sheet coverings.

END OF SECTION 04 44 00
SECTION 05 12 00 - STRUCTURAL STEEL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Bidding Requirements, Contract Forms, Conditions of the Contract and Division 1 - General Requirements apply to the work of this section.

1.02 DESCRIPTION OF THE WORK

A. Work Included: This section covers furnishing all labor, materials, equipment and services in connection with the furnishings, fabrication and erection of all structural steel work complete including:
   1. Steel columns
   2. Steel beams and purlins
   3. Shelf angles
   4. Bolts
   5. Angle frames and openings
   6. Leveling plates and anchor plates not cast in concrete or masonry.
   7. Shop painting

B. Include all supplementary parts and members necessary to complete the structural steel frame, regardless of whether all such parts are definitely shown or specified, and furnish all such bolts, gussets, plates, etc., as may be required for the proper assembly of all items. Workmanship shall be of the best quality known to the trade, and all work shall be carefully assembled, fabricated and erected true to the lines, elevations and designs shown on the Drawings.

C. Related work specified in other sections:
   1. Embedded metal assemblies: Section 03 30 00
   2. Metal Fabrications: Section 05 50 00
   3. Painting: Section 09 90 00

1.03 REFERENCES

A. American Institute of Steel Construction (AISC):

B. American National Standards Institute (NASI)/American Welding Society (AWS):
   1. ANSI/AWS D1.1-81 Structural Welding Code

C. American Society for Testing and Materials (ASTM):
   1. ASTM A 36 Structural Steel
2. ASTM A 325 High-Strength Bolts for Structural Steel Joints.
3. ASTM A 490 Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints.
4. ASTM A 500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
5. ASTM A 501 Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

1.04 DELIVERY, STORAGE AND HANDLING

A. Bolts and other anchorage devices to be embedded in concrete and masonry shall be delivered to the site before the start of concrete and masonry work. Furnish setting drawings and templates for the installation of anchor bolts.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Structural Steel:
   1. ASTM A36 FY=36 ksi, plates, bars, and channels.
   2. ASTM A992 FY=50 ksi, wide flange and tee shapes.

B. Structural tubing: ASTM A 500, Grade C FY=50 ksi, cold-formed welded steel structural tubing.

C. Pipe columns: ASTM A 500, Grade C FY=46 ksi, cold-formed welded steel structural tubing.

D. High-strength threaded fasteners: ASTM A325, Bearing Type bolts, nuts and plain hardened washers. Minimum bolt diameter shall be 3/4".

E. Stud anchors: Headed stud anchors with a smooth shank, or carbon steel with a minimum tensile strength of 65000 psi, and as manufactured by Nelson Stud Welding Div. or KSM Welding Systems Div.


2.02 FABRICATION

A. General: Fabricate structural steel in accordance with referenced specifications.
   1. Drawings indicate the design, sections and weight of members. Make no substitutes except with the written permission of the Architect. Dimensions scaled from the drawings shall not be used for fabrication. Contractor shall, when necessary, measure and determine actual dimensions at the building. All existing building dimensions that might offset the fabrication of steel members shall be verified by the Contractor prior to fabrication.

B. Connections shall conform to the standard specifications of the American Institute of Steel
Construction. All bolted connections shall be “snug tight” type.

C. Punching: Shop-punch steel members for bolts and hanger rods needed to support wood nailers and other items.

D. Marking: Components of high strength steel required to have a yield stress greater than 36 kips/sq. in. shall be clearly marked with the ASTM designation over any shop coat prior to shipment from the fabricator's plant.

E. Shop Painting:
   1. Steel to be encased in concrete or sprayed with fireproofing and steel surface to be welded shall not be painted. Clean this steelwork of oil and grease with solvent cleaner and remove dirt and other foreign matter by sweeping with brushes or with compressed air.
   2. Steelwork shall be given one coat shop paint to a minimum dry film thickness of 1.5 mils. Clean this steelwork of loose mill scale, rust, weld, slag, dirt and other foreign matter. Clean welds of spatter, smoke and iron oxide film. Remove oil and grease with solvent cleaner.
   3. Apply shop paint to dry surfaces thoroughly and evenly by brush, spray, roller coating or dipping at the election of the fabricator.

PART 3 - EXECUTION

3.01 ERECTION

A. Erection of structural metal shall comply with the requirements of referenced codes and standards.
   1. The use of a cutting torch for field connection of fabricating errors will be permitted only with the approval of the Architect. For each fabrication error the Contractor shall submit a drawing of existing conditions and the proposed correction for the Architect's review.
   2. Set column base plates to correct elevations and support temporarily on shims until the columns have been plumbed and grouted.
   3. Make field connections by electric arc welding or with “snug tight” type high strength bolts.

B. Make high strength bolted connections in conformance with "Specifications for Structural Joints Using ASTM A 325 or A490 Bolts" as approved by the Research Council on Riveted and Bolted Structural Joints, August 14, 1980.
   1. Prior to installation, clean bolts, nuts and washers, if required. Dirt and noticeable rust on bolts, nuts and washers will not be allowed.
   2. Where long slotted holes are used, provide plate washers or bars in conformance with Article 3, paragraph (a) 3. of the above mentioned specification.

C. Erect steel framing true and plumb and brace temporarily where necessary to handle all loads to which the structure may be subjected. Such bracing shall be left in place as long as required for safety, and finally shall be removed by the Contractor as part of his equipment. Securely connect all work to take care of dead load, wind and erection stresses.
D. Immediately after erection, clean field welds, field connections and abraded areas of shop paint. Apply paint to exposed areas using same materials as used shop painting. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils, equal to that of the original shop coat.

3.02 FIELD QUALITY CONTROL

A. Perform the following testing and inspection: (Prior to placement of steel deck).
   1. Check temporary bracing of steel frame.
   2. Check location and condition of anchor bolts.
   3. Check plumbness and tolerance of steel frame.
   4. Visually inspect common bolts.
   5. Inspection of high-strength bolting:
      (a) Visually inspect connections.
      (b) Check tightness of at least 33% of connections.
      (c) Check at least two bolts of each girder to column connection.
   6. Visually inspect field and shop welds.
   7. Ultrasonic or X-ray testing of full penetration welds.
   8. Re-inspect corrective measures required at expense of Contractor.
   9. Verify that no members are damaged.
  10. Certify that materials and installation are according to Contract Documents and industry standards.

B. Correction: The fabricator or erector shall correct deficiencies in structural steel work which inspection and test reports have indicated to be not in compliance with the specified requirements. Perform all additional tests required to reconfirm non-compliance of the original work and to show compliance of corrected work.

C. Verify that all welders employed during erection of structural steel are certified for type of base materials and positions encountered. Certification testing to be performed at Contractor’s expense.

END OF SECTION 05 12 00
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Steel floor deck and accessories
B. Steel roof deck and accessories
C. Formed steel deck end forms to contain wet concrete
D. Framed floor and roof openings 18" or less
E. Bearing plates and angles
F. Shear stud connectors

1.2 REFERENCES

A. AISI – Specification for Steel the Design of Cold-Formed Steel Structural Members
B. ASCE 10 - American Society of Civil Engineers – Wind Loads
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel
D. ASTM A108 - Standard Specification for Steel Bars, Carbon, and Alloy, Cold-Finished
E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
F. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
H. ANSI/AWS A2.4 - Symbols for Welding, Brazing and Nondestructive Examination
I. AWS D1.3- Structural Welding Code – Sheet Steel
J. SSPC (Steel Structures Painting Council) - Paint Manual
K. SDI – Steel Deck Institute - Design Manual for Composite Decks, Form Decks, and Roof Decks
L. UL - Fire Resistance Directory

1.3 SUBMITTALS FOR REVIEW

A. Shop Drawings:
   1. Indicate decking plan, support locations, projections, openings and reinforcement, cellular raceways and outlet box locations, pertinent details, cant strips, special joining, anchor details, and accessories.
   2. Provide manufacturer's specifications and installation instructions for each type of decking and accessories.
B. Manufacturer's Mill Certificate: Certify that Products meet or exceed specified requirements.
C. Mill Test Reports: Submit indicating structural strength, destructive and non-destructive test analysis.
D. Welders’ Certificates: Certify welders employed on the Work, verifying AWS qualifications within the previous 12 months.

1.4 QUALITY ASSURANCE
A. Fabricator: Company specializing in performing the work of this section with minimum 5-years documented experience.
B. Installer: Company specializing in performing the work of this section with minimum 5-years documented experience.

1.5 REGULATORY REQUIREMENTS
A. Structural steel design and construction shall comply with IBC, ASCE 10 – Wind loads, and AISI Specification for Steel the Design of Cold-Formed Steel Structural Members.
B. Properly certified Welders shall perform all work in accordance with AWS standards.
C. Conform to UL, FM, and Warnock Hersey Assembly, as necessary for project.

1.6 DELIVERY, STORAGE AND PROTECTION
A. Follow the requirements and recommendations of AISI and Manufacturer for delivery, storage, and protection of materials.

PART 2 PRODUCTS
2.1 MATERIALS
A. Sheet Steel: ASTM A653, Structural Steel Grade, having a minimum yield strength of 33,000 PSI; with G60 galvanized coating conforming to ASTM A525
B. Plates, Angles, Miscellaneous Steel Shapes: ASTM A36/A36M steel, G60 galvanizing coating
D. Galvanizing: ASTM A653/A653M, G60
E. Galvanizing Repair: Damaged galvanized surfaces, prepare surfaces and repair per ASTM A780.
F. Flexible Closure Strips: Use Manufacturer's standard vulcanized, closed cell, synthetic rubber.
G. Paint: Use Manufacturer's baked on, rust-inhibitive paint, for application to metal surfaces, chemically cleaned, and treated with a phosphate chemical.
H. Roof Decking: Provide 3” deep deck units with ribs spaced 8” o.c. Deck plate shall have a flat surface, ribbed top flange is not acceptable and be galvanized (G60) Product/Manufacturer, one of the following:
   a. Vulcraft Steel Deck
   b. New Millennium Building Systems
   c. Wheeling Corrugating Company

2.2 FABRICATION
A. Minimum roof deck material shall be 20-gage sheet steel.
B. Minimum multi-rib (conform) deck material shall be 26-gage sheet steel.
C. Form deck units in lengths to span at least three supports, with flush, telescoped, or nested 2” laps at ends and interlocking or nested side laps, of metal thickness, depth, and width indicated.
D. Roof Deck Units: Provide deck configurations complying with SDI Specifications and Commentary for Steel Roof Deck.
E. Metal Closure Strips:
1. Fabricate metal closure strips, for sell raceways and openings between decking and other construction, of not less than 0.045", minimum 18-gage sheet steel.
2. Form to provide tight-fitting closures at open ends of cells or flutes and sides of decking.

F. Roof Sump Pans:
1. Fabricate from single piece of 0.071", minimum 14-gage galvanized sheet steel with level bottoms and sloping sides to direct water flow to drain.
2. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 3" wide.
3. Recess pans at least 1½" below roof deck surface unless otherwise shown or required by deck configuration.
4. Cut holes for drains in the field by others.

2.3 FINISH

A. Prepare structural component surfaces in accordance with SSPC SP-2.
B. Shop prime structural steel members
   1. Do not prime surfaces scheduled for fireproofing or field welding.
   2. Do not prime surfaces in contact with concrete.
   3. Do not prime surface of high strength bolts.
C. Galvanize steel ledge angle members to ASTM A123/A123M; provide minimum 1.25 oz/sq ft galvanized coating.
D. Shop Painting
   1. Remove all loose scale, rust, and other foreign materials from fabricated joist, girder, and accessories before applying paint.
   2. Spray, dip, or other approved method apply one shop coat of steel primer to steel joist, girder, and accessories, that applies a continuous paint film of at least 1.0 mil.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install deck units and accessories in accordance with manufacturer's requirements, shop drawings, and as specified in this section.
B. Place deck units on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting metal members before being permanently fastening.
   1. Do not stretch or contract side lap interlocks.
C. Align deck units for entire length of run of cells and with closure alignment between cells at ends of abutting units.
D. Place deck units flat and square, secure to adjacent framing without warp or deflection.
E. Do not place deck units on concrete supporting structure until concrete is cure and dry.
F. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
G. Do not use floor deck units for storage or working platforms until permanently secured.
H. Fastening Deck units:
   1. Uplift Loading: Install and anchor roof deck units to resist gross uplift loading, as indicated on plans.
2. Attach roof deck units to steel framework at ends and at intermediate supports per drawings.

3. Fasten side joints of roof decking together with No.10 self-tapping Tek screws, spaced as required to provide the minimum diaphragm strength shown on the structural drawings.

I. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking, as shown on plans.

J. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking, and support of other work as shown.

K. Hanger Slots or Clips: Provide UL-approved punched hanger slots between cells or flutes of lower elements where floor deck units are to receive hangers for support of ceiling construction, air ducts, diffusers, or lighting fixtures.
   1. May use hanger clips designed to clip over male side lap joints of floor deck units instead of hanger slots.
   2. Locate slots or clips not more than 14" oc in both directions, not over 9" from walls at ends, and not more than 12" from walls at sides, unless indicated otherwise.
   3. Provide manufacturer's standard hanger attachment devices.

L. Joint Covers: Provide metal joint covers at abutting ends and changes in direction of floor deck units, except at taped joints.

M. Roof Sump Pans: Place them over openings in roof decking and weld to top decking surface, spacing the welds not more than 12" oc with at least one weld at each corner.

N. Closure Strips: Provide and weld metal closure strips at open uncovered ends and edges of roof decking and in voids between decking and other construction to provide complete decking installation.
   1. Provide and install flexible closure strips instead of metal closures, at Contractor's option, wherever their use ensures complete closure, use adhesive per manufacturer's instructions.
   2. Install foam or rubber closures to reduce thermal breaks and to make airtight between top of walls and bottom of deck in the following locations:
      a. At all exterior walls.
      b. At all interior walls between conditioned and unconditioned spaces, and between conditioned and tempered (heated only) spaces.
      c. In addition to installing closures, seal air barriers to underside of deck to prevent air leakage (Refer to Division 07, “Bituminous Damp proofing” and “Air Barrier” Section(s).

O. Touch-Up Painting: After decking installation, wire brush, clean, and paint scarred areas, welds, and rust spots and bottom surfaces of decking units and supporting steel members.
   1. Touch-up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions.
   2. Touch-up painted surfaces with same type of shop paint used on adjacent surfaces.
   3. In areas of exposed shop painted surfaces, apply touch-up paint to blend into adjacent surfaces.

P. Ridge and Valley Plates:
   1. Weld ridge and valley plates to the top surface of the roof decking.

Q. Lap end joints not less than 3", with laps made in the direction of water flow. Repair and Valley Plates:
   1. Holes up to ½" in diameter fill with urethane or silicone sealant and cover with duct tape.
2. Holes over ½" diameter require sheet metal plate patches fastened to deck.

3.2 OPENINGS

A. At deck openings provide steel angle reinforcement indicated on Drawings. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and weld to deck at each flute.

B. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.

3.3 HANGING LOADS

A. Mechanical equipment or other loads shall not be hung from metal deck unless specifically indicated and detailed on Drawings. Method of attachment subject to review by Architect and Engineer.

3.4 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Power or air actuated pin manufacturer Quality Control Representative shall inspect fastener installation to verify proper installation requirements are met.

B. Correct deficiencies in products and installation found not to follow Contract Documents.

END OF SECTION 05 30 00
SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 01 Specification Sections, apply to this Section.
   B. General Contractor shall coordinate construction operations included in different Sections of
      the Specifications to ensure efficient and orderly installation of each part of the Work that
      depend on each other for proper installation, connection, and operation.

1.02 SUMMARY
   A. General: Furnish all labor, supervision, materials, tools, equipment, appliances and services
      necessary for the fabrication, delivery and installation of all miscellaneous metal items. All
      work shall be as shown or indicated on the drawings and as specified in this section.
   B. Scope of Work:
      1. Embedded angles and plates
      2. Steel Equipment Supports
      3. Downspout Protection
      4. Miscellaneous metal work and related items.
      5. Shop Priming and Finishing of Metal Fabrications
   C. Related Sections include the following:
      1. Division 03 Section - Concrete.
      2. Division 04 Section - Unit Masonry.
      3. Division 06 Section - Rough Carpentry, for concealed blocking for attachment of metal
         fabrications.
      4. Division 09 Section - Painting.
      5. Division 09 Section – High Performance Coatings.

1.03 PERFORMANCE REQUIREMENTS
   A. Design Criteria:
      1. Connections other than those already listed shall be designed to safely support design
         load (dead load plus live load) of not less than 100 psi without exceeding working
         stresses permitted for materials.
      2. Miscellaneous countertop supports designed to safely support a load of 200 lb per linear
         foot of countertop applied at the outside edge, as well as any additional requirements as
         specified in Division 06 Section - Architectural Woodwork.
      3. Miscellaneous equipment supports per local code requirements, equipment
         Manufacturers’ requirements and as specified herein.

1.04 QUALITY ASSURANCE
   A. Steel stairs in accordance with latest NAAMM Standards and AISC.
   B. Welding shall conform to American Welding Society's Standard Code for Arc and Gas
      Welding in Building Construction. Welding shall be continuous along entire area of contact,
      except where tack welding is specifically shown or specified. Grind all exposed welds.
1.05 SUBMITTALS
A. Shop drawings based on the Contract Documents shall be submitted to the Architect for review prior to ordering of materials.
B. Failure by the contractor to submit shop drawings, test reports, etc. required above shall release the Architect and the Engineer from any liabilities due to the negligence on the part of the contractor to comply with the construction documents.
C. Approval will cover size and arrangement of members, character of construction, but not dimensions.
D. Contractor shall verify actual dimensions at the construction site.

PART 2 - PRODUCTS

2.01 MATERIALS
A. Comply with the following standards, as pertinent:
   1. Steel plates, shapes, and bars: ASTM A36;
   2. Steel plates to be bent or cold-formed: ASTM A283; grade C;
   3. Steel tubing (hot-formed, welded, or seamless): ASTM A500; grade B;
   4. Steel bars and bar-size shapes: ASTM A306; grade 65, or ASTM A36;
   5. Cold-finished steel bars: ASTM A1081
   6. Cold-rolled carbon steel sheets: ASTM A336;
   7. Galvanized carbon steel sheets: ASTM A526, with G90 zinc coating in accordance with ASTM A525;
   8. Stainless steel sheets: AISI type 302 or 304, 24 ga. with number 4 finish;
   9. Gray iron castings: ASTM A48, class 10;
   10. Malleable iron castings: ASTM A47;
   11. Steel pipe: ASTM A53, grade A, schedule 40, black finish unless otherwise noted;
   12. Concrete inserts:
      a. Threaded or wedge-type galvanized ferrous castings of malleable iron complying with ASTM A27.
      b. Provide required bolts, shims, and washers, hot-dip galvanized in accordance with ASTM A153.
   13. Bolts and nuts: Provide hexagon-head regular type complying with ASTM A307, grade A.
   14. Lag bolts: Provide square-head type complying with Fed Spec FF-B-561;
B. Castings shall be made from the best grade of soft pig iron cast in stove place molding sand to a uniform thickness. Castings shall be free of defects impairing strength or appearance.
C. Accessories: Provide all anchors bolts, anchor straps, hangers and other related fittings, fastener and accessories required for proper and secure installation of all miscellaneous metal. Fasteners for exterior use shall be zinc coated. Generally, the sizes, shapes and spacing of items are shown or specified; where not shown or specified, accessories shall be adequate for the required services, subject to approval.

2.02 ITEMS TO BE PROVIDED
A. Lintel Angles and Bent Plates: Refer to Structural Drawings.
B. Miscellaneous Equipment Supports: Field verify all dimensions and provide miscellaneous steel support structure for wall and ceiling mounted equipment as follows:
   1. For large ceiling fans as indicated in Drawings.
2. Where not specifically detailed, design and provide supports as required for all other equipment to be provided or installed under this contract.

3. All supports shall comply with requirements of the equipment Manufacturer(s) for support structure and shall provide adequate strength and secure attachment to building structure, braced against lateral movement.

C. Downspout Boots: Equal to Barry Pattern and Foundry, B-26 series.
   1. Cast Iron Downspout Boot (for discharge to below grade pipe): Sized to match downspouts, with removable cleanout port, top of boots mounted 3'-0” above finish floor. Coordinate overall lengths of boots with grading plan for below grade connection to drainpipes.

D. Miscellaneous Steel Shapes: Channels, angles, plates, tubing, connections and bolts provided where shown and detailed on drawings. Exterior imbed plates, support angles, and other miscellaneous exterior steel shall be hot-dip galvanized.

2.03 SHOP PAINTING
   A. All Iron and Steel Work: Unless otherwise specified, power tool clean all surfaces to remove mill scale. Work shall receive a shop coat of paint before leaving the factory or being exposed to the weather. Aluminum work contacting dissimilar metals shall receive a protective coating preventing galvanic action.
   B. Shop Paint: Shop paint shall be Fabricator's standard, fast curing, lead free, "universal" primer, compatible with finish paint system indicated and for capability to provide sound foundation for field applied topcoats.
   C. Aluminum surfaces to be in direct contact with concrete and masonry shall be shop coated with zinc chromate primer.

PART 3 - EXECUTION

3.01 FABRICATION
   A. Contractor shall secure and be responsible for all field measurements required for the proper and accurate fabrication and installation of the items included under this section; field alterations will not be permitted except upon specific authorization of the Architect.
   B. All work shall be assembled in the most substantial manner and reinforced where necessary with structural shapes, using concealed screws, bolts or similar fastenings. Make welds of adequate strength and durability, jointing tight, clean and smooth, flush and in true plane with base metals.
   C. All screws or rivets shall be countersunk, unless otherwise noted. Provide lock washers for all bolts.
   D. All steel to which wood blocking is connected shall be properly punched for anchoring blocking.
   E. Exposed steel shapes with marred surfaces shall be ground or draw-filled to a fine grain finish, as approved before applying shop coat of paint.
   F. Assembled work shall be completely constructed in the shop, accurately finished and the pieces match-marked for erection. Form exterior joints to exclude water, grind connections in exposed pieces smooth and polish.
   G. The Contractor shall do all drilling, cutting, tapping and fitting of work to accommodate other work coming in contact with it, and shall furnish all taps, bolts and other fittings in connection therewith.
H. Except where otherwise noted, fastening to concrete, solid masonry or hollow masonry shall be with expansion bolts or anchors. Fastening to wood plugs will not be permitted. Toggle bolts may be used only when approved by the Architect.

3.02 INSTALLATION, GENERAL
A. All work included in this Contract shall be installed by the Contractor at the proper time and as rapidly as the progress of the adjacent and connecting work will permit.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true to line, and free of rack; and measured from established lines and levels.

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

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

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

F. Immediately after erection, clean the field welds, bolted connections, and abraded areas of shop priming. Paint the exposed areas with same material used for shop priming.

G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

3.03 INSTALLATION, SPECIFIC ITEMS
A. Miscellaneous Framing and Supports:
   1. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
   2. Anchor supports securely to and rigidly brace from building structure.

3.04 ADJUSTING AND CLEANING
A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 50 00
SECTION 05 50 05 - LANDSCAPE METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Shop fabricated metal components.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. American Welding Society (AWS):
   1. D1.1/D1.1M - Structural Welding Code - Steel.
   2. D1.6/D1.6M - Structural Welding Code - Stainless Steel.

B. ASTM International (ASTM):
   6. A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   7. A588/A588M - Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance.

1.3 SYSTEM DESCRIPTION

A. Minimum Design Loads:
   1. Pedestrian loading:
      a. Uniform load of 100 PSF.
      b. Concentrated load of 300 pounds.
      c. Maximum deflection under loading: L/240.
   2. Vehicular loading:
      a. Uniform load of 500 PSF.
      b. Concentrated load of 2000 pounds.
      c. Maximum deflection under loading: L/240.
   3. Concentrated and uniform loads do not need to be applied simultaneously.
   4. Perform design under direct supervision of Professional Structural Engineer licensed in State in which Project is located, with minimum 2 years experience in work of this Section.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Show dimensions, metal thicknesses, finishes, joints, attachments, and relationship of work to adjacent construction.
1.5 DELIVERY, STORAGE AND HANDLING

A. Store steel above ground on platforms, skids, or other supports; separate with wooden separators.

B. Protect steel from corrosion.

C. Prevent damage to shop-applied coatings.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Shapes: ASTM A36/A36M.

B. Plate: ASTM A283.

C. Tube: ASTM A500/A500M.

2.2 MATERIALS - WEATHERING STEEL

A. Shapes: ASTM A588/A588M.

B. Plate: ASTM A242/A242M.

2.3 MATERIALS - STAINLESS STEEL

A. Stainless Steel: ASTM A276/A276M, Type 316.

2.4 ACCESSORIES

A. Exposed Screws: Same material as metal being fastened; Phillips flat head, countersunk, unless noted otherwise.

B. Anchoring Cement: Non-shrink cementitious type.

2.5 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of component except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

F. Conceal fastenings where possible.
G. Welding to conform to AWS D1.1/D1.1M and D1.6/D1.6M:
   1. Use welds for permanent connections where possible. Grind exposed welds smooth.
   2. Tack welds prohibited on exposed surfaces.

2.6 FINISHES

   A. Weathering Steel: Mill finish.
   B. Stainless Steel: NAAMM AMP 503; No. 4 satin.

PART 3 EXECUTION

3.1 INSTALLATION

   A. Install items in accordance with approved Shop Drawings.
   B. Install components plumb, level, and rigid.
   C. Welding: AWS D1.1/D1.1M and D1.6/D1.6M. Grind and fill exposed welds; finish smooth and flush.
   D. Install sleeved components with anchoring cement.
   E. Prevent contact of dissimilar metals by use of zinc rich paint, bituminous coating, or non-absorptive gaskets.

END OF SECTION 05 50 05
PART 1  GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel guard rails and handrails.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES


B. ASTM International (ASTM):
   4. A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Show dimensions, metal thicknesses, finishes, joints, attachments, and relationship of work to adjacent construction.

B. Quality Control Submittals:
   1. Certificate of Compliance from Professional Structural Engineer performing system design.

1.4 SYSTEM DESCRIPTION

A. Minimum Design Loads:
   1. Guard rails and handrails:
      a. 50 pounds per linear foot applied in any direction at top, transferred via attachments and supports to building structure.
      b. Concentrated 200 pound load applied in any direction at any point along top, transferred via attachments and supports to building structure.
      c. Maximum deflection under loading: L/120.
   2. Concentrated and uniform loads do not need to be applied simultaneously.
   3. Perform design under direct supervision of Professional Structural Engineer licensed in State in which Project is located, with minimum 2 years experience in work of this Section.

B. Fabricate guard rails and handrails in accordance with ASTM E985.
1.5 QUALITY ASSURANCE
   A. Installer Qualifications: Minimum 2 years experience in work of this Section.

1.6 DELIVERY, STORAGE AND HANDLING
   A. Store components above ground on platforms, skids, or other supports; separate with wooden separators.
   B. Protect steel from corrosion.
   C. Prevent damage to shop-applied coatings.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL
   A. Shapes: ASTM A36/A36M.
   B. Plate: ASTM A283.
   C. Tube: ASTM A500/A500M.

2.2 ACCESSORIES
   A. Exposed Screws: Same material as metal being fastened; Phillips flat head, countersunk, unless noted otherwise.
   B. Anchoring Cement: Non-shrink cementitious type.

2.3 FABRICATION
   A. Fabricate guardrails and handrails from steel stock of sizes and types indicated.
   B. Cut intersections square to within 2 degrees and to length within 1/8 inch. Remove burrs from cut ends.
   C. Miter and cope intersections within 2 degrees, fit to within 1/8 inch.
   D. Continuously weld connections. Welding to conform to AWS D1.1/D1.1M:
      1. Use welds for permanent connections where possible. Grind exposed welds smooth.
      2. Tack welds prohibited on exposed surfaces.
   E. Where length exceeds that suitable for shipping and handling, fabricate in sections with concealed internal sleeves forming slip joints. Extend sleeves minimum 2 inches on both sides of joint; field weld and grind smooth.
   F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of component except where specifically noted otherwise.
   G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
H. Conceal fastenings where possible.

2.4 FINISHES

A. Steel: Galvanized, ASTM A123/A123M, to 2.0 ounces per square foot.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install items in accordance with approved Shop Drawings.

B. Install components plumb, level, and rigid.

C. Welding: AWS D1.1/D1.1M. Grind and fill exposed welds; finish smooth and flush.

D. Install sleeved components with anchoring cement.

E. Prevent contact of dissimilar metals by use of zinc rich paint, bituminous coating, or non-absorptive gaskets.

3.2 ADJUSTING

A. Clean and touch up galvanized coatings at welded and abraded surfaces in accordance with ASTM A780, Annex A2.

END OF SECTION
SECTION 06 10 00 - ROUGH CARPENTERY

PART 1 - GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      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.
     10. Plywood backing
   B. Related Requirements:
      1. Section 061324 "Heavy Timber Construction."
      2. Section 061600 "Sheathing."
      3. Section 313116 "Termite Control" for site application of borate treatment to wood
         framing.

1.03 DEFINITIONS
   A. Exposed Framing: Framing not concealed by other construction.
   B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5
      inches nominal (114 mm actual) in least dimension.
   C. Timber: Lumber of 5 inches nominal (114 mm actual) or greater in least dimension.
   D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
      2. NLGA: National Lumber Grades Authority.
      3. RIS: Redwood Inspection Service.
      5. WCLIB: West Coast Lumber Inspection Bureau.

1.04 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.

5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.05 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.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, General
A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded 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, omit grade stamp and provide certificates of grade compliance issued by grading agency.
   3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   4. Provide dressed lumber, $4S$, unless otherwise indicated.
B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.
C. Engineered Wood Products: Provide 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: Provide engineered wood products with allowable design stresses, as published by manufacturer, that 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.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER
A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground.
contact with the ground, and Use Category UC4a for items in contact with the ground.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do 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, omit marking and provide certificates of treatment compliance issued by inspection agency.

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

2.03 FIRE-RETARDANT-TREATED MATERIALS
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 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. 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 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 ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.
C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry
plywood after treatment to a 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, omit marking and provide certificates of treatment compliance issued by testing agency.

E. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat items indicated on Drawings, and the following:
   1. Framing for raised platforms.
   2. Concealed blocking.
   3. Roof construction.
   4. Plywood backing panels.

2.04 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Refer to Architectural Drawings.
   1. Application: Interior partitions not indicated as load-bearing.
   2. Species:
      a. Southern Pine No. 2

B. Load-Bearing Partitions: No. 3 grade.
   1. Application: As indicated

C. Ceiling Joists: Construction or No. 2.
   1. Species:
      a. Southern pine; SPIB.

D. Joists, Rafters, and Other Framing Not Listed Above: See structural documents.
   1. Species:
      a. Southern pine; SPIB.

E. Exposed Framing: Provide material hand-selected 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. Application: Exposed exterior and interior framing indicated to receive a stained or natural finish.
   2. Species and Grade: As indicated above for load-bearing construction of same type.

2.05 ENGINEERED WOOD PRODUCTS

A. Engineered Wood Products, General: Products shall contain no urea formaldehyde.

B. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.

C. 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.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      b. Finnforest USA.
      c. Georgia-Pacific.
      d. Jager Building Systems Inc.
      e. Louisiana-Pacific Corporation.
f. Pacific Woodtech Corporation.
g. Roseburg Forest Products Co.
h. Standard Structures Inc.
i. Stark Truss Company, Inc.
j. West Fraser Timber Co., Ltd.
k. Weyerhaeuser Company.

D. 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. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Louisiana-Pacific Corporation.
   b. Weyerhaeuser Company.

2.06 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. For items of dimension lumber size, provide Construction or No. 2 as indicated:

C. 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.

D. 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.

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

2.07 FASTENERS

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

1. Where rough carpentry is exposed to weather, in ground contact, 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.


D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.


2.08 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Simpson Strong-Tie Co., Inc.

C. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that 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.


1. Use for interior locations unless otherwise indicated.

E. 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.

F. 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: 0.062 inch (1.6 mm).

G. 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: 0.062 inch (1.6 mm).

H. 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: 2 inches (50 mm).
2. Thickness: 0.062 inch (1.6 mm).

I. Bridging: Rigid, V-section, nailless type, 0.050 inch (1.3 mm) thick, length to suit joist size and spacing.

J. 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.

K. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.

1. Width: 1-1/4 inches (32 mm).
2. Thickness: 0.062 inch (1.6 mm).
3. Length: As indicated.
L. Rafter Tie-Downs: As indicated.
M. Rafter Tie-Downs (Hurricane or Seismic Ties): As indicated.
N. Floor-to-Floor Ties: As indicated.
O. Hold-Downs: As indicated.
P. 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.
Q. 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.

2.09 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 spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
D. Adhesives for Gluing to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
   1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
E. 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
3.01 INSTALLATION, GENERAL
A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
E. Shear Wall Panels: Install shear wall panels to comply with manufacturer's written instructions.
F. Metal Framing Anchors: 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 will 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 napthenate for items not continuously protected from liquid water.
M. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   3. 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.
N. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
O. 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 indicated 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.
3.02 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.
B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
D. 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.

3.03 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 horizontally and vertically 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.

3.04 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. Fasten plates to supporting construction unless otherwise indicated.
   1. For exterior walls, provide 2-by-6-inch nominal- (38-by-140-mm actual) size wood studs spaced 16 inches (406 mm) o.c. unless otherwise indicated.
   2. For interior partitions and walls, provide as indicated.
   3. Provide continuous horizontal blocking at midheight of partitions more than 96 inches (2438 mm) high, using members of 2-inch nominal (38-mm actual) thickness and of same width as wall or partitions.
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 jams as indicated.

3.05 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 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 1/3 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.

3.06 CEILING JOIST AND RAFTER FRAMING INSTALLATION

A. Ceiling Joists: Install ceiling joists 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 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.

3.07 TIMBER FRAMING INSTALLATION

A. Install timber 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) air space 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.

3.08 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.

3.09 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 sufficiently wet 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 06 10 00
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Wood blocking, cants and nailers.
   2. Wood furring and grounds.
   3. Wood sleepers.
   4. Plywood.

B. Related Requirements:
   1. Division 3 Section “Concrete Formwork.”
   2. Division 5 Section “Metal Fabrications.”
   3. Division 6 “Interior Architectural Woodwork.”
   4. Division 8 “Hollow Metal Doors and Frames.”
   5. Division 8 “Flush Wood Doors.”
   6. Division 8 “Door Hardware.”
   7. Division 9 “Paint.”
   8. Division 10 “Toilet Accessories.”

1.03 DEFINITIONS

A. Exposed Framing: Framing not concealed by other construction.

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

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

D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   2. NLGA: National Lumber Grades Authority.
   3. RIS: Redwood Inspection Service.
   5. WCLIB: West Coast Lumber Inspection Bureau.

1.04 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. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.05 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.
   5. Expansion anchors.
   6. Metal framing anchors.

1.06 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.

1.07 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded 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, omit grade stamp and provide certificates of grade compliance issued by grading agency.
   3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   4. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

C. Engineered Wood Products: Provide 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: Provide engineered wood products with allowable design stresses, as published by manufacturer that 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.
2.02 WOOD-PRESERVATIVE-TREATED LUMBER

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

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do 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, omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat all rough carpentry unless otherwise indicated 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 above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 FIRE-RETARDANT-TREATED MATERIALS

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 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 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 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 ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.
C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

E. Application: Treat all rough carpentry unless otherwise indicated, 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.

2.04 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. For items of dimension lumber size, provide Construction or No. 2 and the following species:
   1. Hem-fir (north); NLGA.
   2. Mixed 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. Eastern softwoods; NeLMA.

C. For utility shelving, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
   1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine.
   2. Mixed southern pine; No. 1 grade; SPIB.
   3. Spruce-pine-fir (south) or spruce-pine-fir.

D. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
   1. Mixed southern pine; No. 2 grade; SPIB.
   2. Spruce-pine-fir (south) or spruce-pine-fir.
   3. Western woods; Construction or No. 2 Common.

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.
2.05 PLYWOOD PRODUCTS:
1. All lumber shall be kiln dried to a moisture content of 4-1/2 percent. Kiln dried lumber shall be tempered for not less than four weeks before using.
2. Softwood Plywood for Laminate finish: DOC PS 1, at semi-exposed surfaces unless noted otherwise.

2.05 PLYWOOD BACKING PANELS
A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.
   1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.06 FASTENERS
A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. Where rough carpentry is exposed to weather, in ground contact, 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.
D. Wood Screws: ASME B18.6.1.
E. Lag Bolts: ASME B18.2.1.
F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
   2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.07 MISCELLANEOUS MATERIALS
A. Sill-Sealer Gaskets: 5-1/2” x 3/8” closed cell foam and adhesive backed peel and stick membrane, equal to Protecto Wrap (800-759-9727) “Triple Guard Energy Sill Sealer.”
B. Insect Screen: Provide custom sized insect screen as indicated on Drawings at the Shower building, equal to Window Screen Pros
   2. Frame Color: Bronze

PART 3 - EXECUTION
3.01 INSTALLATION, GENERAL
A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit.
Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

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

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

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

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

F. Fastenings for Wall Supported Items: Provide and install 2 x 8 (minimum) x 1 stud space wood blocking, unless specified otherwise at all stud wall areas receiving grab bars, toilet partitions, wall bumpers and other wall mounted accessories.

G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

H. Sort and select lumber so that natural characteristics will 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.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   3. 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.

J. 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.

K. 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 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.

3.02 WOOD GROUND, SLEEPER, 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.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.03 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- size furring horizontally and vertically at 24 inches o.c.

C. Furring to Receive Gypsum Board, Plaster Lath: Install 1-by-2-inch nominal- size furring vertically at 16 inches o.c.

3.04 ROUGH HARDWARE

A. Provide bolts, screws, anchors, inserts and fastenings required for proper attachment of carpentry and millwork items. Fastenings to concrete or masonry with expansion bolts or anchors. Toggle bolts may be used for hollow masonry. Fastening to wood plugs not permitted. Fastenings spaced 16" o.c. unless otherwise noted.

3.05 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.

END OF SECTION 06 10 15
SECTION 06 13 24 - HEAVY TIMBER FRAMING

PART 1 - GENERAL

1.01 SECTION INCLUDES
   A. Heavy structural timber for posts, columns, and beams.
   B. Connection hardware.

1.02 RELATED REQUIREMENTS
   A. Section 03 10 00 - Concrete Forming and Accessories: Placement of steel support fabrications.
   B. Section 05 12 00 - Structural Steel Framing: Steel support fabrications.
   C. Section 05 50 00 - Metal Fabrications: Steel support fabrications.
   D. Section 06 10 00 – Rough Carpentry
   E. Section 06 18 00 – Glued-Laminated Construction

1.03 REFERENCE STANDARDS
   A. AITC 108 - Standard for Heavy Timber Construction; American Institute of Timber Construction; 1993.
   E. RIS (GR) - Standard Specifications for Grades of California Redwood Lumber; Redwood Inspection Service; 2000.

1.04 SUBMITTALS
   A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings: Indicate dimensions, wood species and grades, component profiles, drilled holes, fasteners, connectors, erection details and sequence.
   C. Product Data: Submit data on proprietary connection devices.
   D. Product Data: Submit technical data on wood preservative materials, application instructions.
   E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE
   A. Lumber Grading Agency: Certified by American Lumber Standards Committee.
   B. Manufacturer Qualifications: Company specializing in manufacture of heavy timber framing, certified by American Institute of Timber Construction, with three years minimum experience.

PART 2 PRODUCTS

2.01 WOOD MATERIALS
   A. Wood fabricated from old growth timber is not permitted.
   B. Lumber Grading Rules: Refer to S1.0
C. Lumber: Refer to S1.0; maximum moisture content of 19 percent.

2.02 ACCESSORIES
A. Connectors: Type weldable steel. Designed and provided by contractor.
   1. Prime connectors, except where cast in concrete.
B. Bolts, Nuts, Washers, Lags, and Screws, Untreated Wood: Medium carbon steel; galvanized coating per ASTM A 153/A 153M; size and type to suit application.
C. Bolts, Nuts, Washers, Lags, and Screws, Preservative-Treated Wood: Stainless steel; size and type to suit application.

2.03 FABRICATION
A. Fabricate components in accordance with AITC 108, with joints neatly fitted, welded, and ground smooth.
B. Perform welding in accordance with AWS D1.1.

2.04 WOOD TREATMENT
A. Wood Preservative (Pressure Treatment): AWPA Standard U1, Use Category UC3B, Commodity Specification A using waterborne preservative to 0.25 lb/cu ft retention.
   1. Product: Standard as provided by manufacturer
B. Wood Preservative (Surface Application):
   1. Product: Standard as provided by manufacturer

PART 3 EXECUTION
3.01 PREPARATION
A. Ensure that steel support fabrications are installed in correct locations and anchored securely.

3.02 ERECTION
A. Set structural members level and plumb, in correct position.
B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.
C. Do not field cut or alter structural members without approval of Architect.
D. After erection, touch-up primed surfaces with primer.

3.03 SITE APPLIED WOOD TREATMENT
A. Brush apply one coats of preservative treatment on wood in contact with cementitious materials and roofing and related metal flashings.
B. Apply preservative treatment in accordance with manufacturer's instructions.
C. Treat site-sawn ends.
D. Allow preservative to cure prior to erecting members.

END OF SECTION 06 13 24
SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Wall sheathing.
   2. Roof sheathing.

B. Related Requirements:
   1. Division 06 Section - Rough Carpentry for plywood backing panels and wood floor decking and underlayments.
   2. Division 07 Section - Air Barriers for water-resistive barrier applied over wall sheathing.
   3. Division 07 Section - Metal Roof Panels.
   4. Division 07 Sections for roofing types over roof sheathing.
   5. Division 07 Section - Sheet Metal and Flashing.

1.03 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 a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.04 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For following products, from ICC-ES:
   1. Preservative-treated wood panel products.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.
   1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
B. 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.

1.06 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

2.01 PERFORMANCE REQUIREMENTS
A. Design roof sheathing fastener patterns to requirements as specified for roofing, wind pressures as indicated in Structural Drawings, and requirements of local codes and authorities having jurisdiction, whichever is most stringent.

2.02 WOOD PANEL PRODUCTS
A. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
B. Oriented Strand Board: DOC PS 2.
C. Thickness: As needed to comply with requirements specified, but not less than thickness indicated in Drawings.
   1. Refer to structural Drawings and specifications for requirements where sheathing acts as a shear wall or roof diaphragm.
D. Factory mark panels to indicate compliance with applicable standard.

2.03 PRESERVATIVE-TREATED WOOD PANEL PRODUCTS
A. Preservative Treatments by Pressure Process: AWPA U1 for uses indicated; and as follows:
   1. Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
   2. At treated materials in contact with metal, use only non-corrosive type preservatives or provide separation between metal surfaces and materials treated with corrosive chemicals.
B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.
D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
E. Application: Treat all plywood not specified or shown to receive preservative treatment.

2.04 ROOF & WALL SHEATHING
A. Sheathing:
   1. Nominal Thickness: Comply with minimum thicknesses and requirements as indicated in Structural Drawings.

2.05 FASTENERS
A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. Unless otherwise noted, for fasteners at ACQ or corrosive treated wood, provide stainless steel fasteners, or fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.
D. Wood Screws: ASME B18.6.1.

2.06 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS
A. Refer to Division 7 Section(s) for joint treatment requirements for liquid applied air barrier membranes.

PART 3 - EXECUTION

3.01 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. Unless otherwise indicated, fit tightly against abutting construction, except provide a 3/8" setback where non-load-bearing construction abuts structural elements.
C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
D. Use common wire nails for attaching sheathing to wood framing 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 sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through the 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 precipitation is forecast.

END OF SECTION 06 16 00
PART 1 - GENERAL

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

1.02 SUMMARY
   A. Section includes framing using structural glued-laminated timber.
   B. Related Requirements:
      1. Section 061000 "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.
      2. Section 061324 "Heavy Timber Framing" for framing using columns.

1.03 DEFINITIONS
   A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.04 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include data on lumber, adhesives, fabrication, and protection.
      2. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
      3. For connectors include installation instructions.
         a. Submit physical samples of connectors exposed to view to architect for review and approval.
   B. Shop Drawings:
      1. Show layout of structural glued-laminated timber system and full dimensions of each member.
      2. Indicate species and laminating combination.
3. Include large-scale details of connections.

C. Samples: Full width and depth, 24 inches (600 mm) long, showing the range of variation to be expected in appearance of structural glued-laminated timber, including variations due to specified treatment.

1. Apply specified factory finish to three sides of half-length of each Sample.

D. Delegated-Design Submittal: For structural glued-laminated timber and timber connectors.

1.05 INFORMATIONAL SUBMITTALS

A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.

B. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.

C. Research/Evaluation Reports: For structural glued-laminated timber and timber connectors, from ICC-ES.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm, certified for chain of custody by an FSC-accredited certification body.

1.07 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with provisions in AITC 111.

B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design structural glued-laminated timber and connectors.

B. Structural Performance: Structural glued-laminated timber and connectors shall withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in AITC 117 or determined according to ASTM D 3737 and acceptable to authorities having jurisdiction.

2.02 STRUCTURAL GLUED-LAMINATED TIMBER

A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.
1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.

2. Provide structural glued-laminated timber made from single species.

3. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.

4. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.

5. Adhesive shall not contain urea-formaldehyde resins.

6. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Certified Wood: Glued-laminated timber shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

C. Species and Grades for Structural Glued-Laminated Timber: Douglas fir-larch or Southern pine in grades needed to comply with "Performance Requirements" Article.

D. Species and Grades for Structural Glued-Laminated Timber: Douglas fir-larch or Southern pine, that complies with the structural properties and beam stress classifications indicated in the structural drawings.

E. Species and Grades for Beams and Purlins:
   1. Species and Beam Stress Classification Douglas fir-larch, 24F-1.8E; Southern pine, 24F-1.8E.
   2. Lay-up: Either balanced or unbalanced.

F. Appearance Grade: Architectural, complying with AITC 110.
   1. For Premium and Architectural appearance grades, fill voids as required by AITC 110

2.03 PRESERVATIVE TREATMENT

A. Preservative Treatment: Where preservative-treated structural glued-laminated timber is indicated, comply with AWPA U1, Use Category 3B.
   1. Use preservative solution without water repellents or substances that might interfere with application of indicated finishes.
2. Do not incise structural glued-laminated timber or wood used to produce structural glued-laminated timber.

B. Preservative: [One of the following:]
   1. Oxine copper (copper-8-quinolinolate) in a light petroleum solvent.
   2. Pentachlorophenol in light petroleum solvent.
   3. Copper naphthenate in a light petroleum solvent.
   4. Ammoniacal zinc copper arsenate (ACZA) in a water solution.
   5. Chromated copper arsenate (CCA) in a water solution.
   6. Ammoniacal copper quat Type A (ACQ-C) in a water solution.
   7. Propiconazole tebuconazole imidacloprid (PTI) in a water emulsion.

C. After dressing members, apply a copper naphthenate field-treatment preservative to comply with AWPA M4 to surfaces cut to a depth of more than 1/16 inch (1.5 mm).

2.04 TIMBER CONNECTORS

A. Fabricate beam seats from steel with 3/8-inch (9.5-mm) bearing plates, 3/4-inch- (19-mm-) diameter-by-12-inch- (300-mm-) long deformed bar anchors, and 0.239-inch (6-mm) side plates.

B. Fabricate beam hangers from steel with 0.179-inch (4.6-mm) stirrups and 0.239-inch (6-mm) top plates.

C. Fabricate strap ties from steel, 3 inches (75 mm) wide by 0.239 inch (6 mm) thick.

D. Fabricate tie rods from round steel bars with upset threads connected with forged-steel turnbuckles complying with ASTM A 668/A 668M.

E. Provide bolts, 3/4 inch (19 mm) unless otherwise indicated, complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); nuts complying with ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

F. Provide shear plates, 4 inches (102 mm) in diameter, complying with ASTM D 5933.

G. Materials: Unless otherwise indicated, fabricate from the following materials:
   1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.
   2. Round steel bars complying with ASTM A 575, Grade M 1020.
   3. Hot-rolled steel sheet complying with ASTM A 1011/A 1011M, Structural Steel, Type SS, Grade 33.

H. Finish steel typical assemblies and fasteners with rust-inhibitive primer, 2-mil (0.05-mm) dry film thickness.
1. Primer shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2. 
   I. Hot-dip galvanize (G-60) steel assemblies and fasteners after fabrication to comply with ASTM A 123/A 123M or ASTM A 153/A 153M.
   J. Connectors exposed to view shall be Simpson “Avant” style with a black powder-coat or similar finish, or equal, subject to approval of architect.

2.05 MISCELLANEOUS MATERIALS

A. End Sealer: Manufacturer’s standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.

B. Penetrating Sealer: Manufacturer’s standard, transparent, penetrating wood sealer that is compatible with indicated finish.

C. Sealers shall comply with the testing and product requirements of the California Department of Public Health’s (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.06 FABRICATION

A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
   1. Dress exposed surfaces as needed to remove planning and surfacing marks.

B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.

C. Where preservative-treated members are indicated, fabricate (cut, drill, surface, and sand) before treatment to greatest extent possible. Where fabrication must be done after treatment, apply a field-treatment preservative to comply with AWPA M4.
   1. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
   2. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.

D. End-Cut Sealing: Immediately after end cutting each member to final length, and after preservative treatment, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.
E. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit, except for preservative-treated wood where treatment included a water repellent.

2.07 FACTORY FINISHING

A. Wiped Stain Finish: Manufacturer’s standard, dry appearance, penetrating acrylic stain and sealer; oven dried and resistant to mildew and fungus.
   1. Color: As selected by Architect from manufacturer’s full range.

B. Clear Finish: Manufacturer's standard, two-coat, clear varnish finish; resistant to mildew and fungus.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.

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

3.02 INSTALLATION

A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
   1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.

B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

C. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing and finishing.
   1. Predrill for fasteners using timber connectors as templates.
   2. Finish exposed surfaces to remove planning or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
   3. Coat cross cuts with end sealer.
   4. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWPA M4.
a. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.

b. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.

D. Install timber connectors as indicated.
   1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
   2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.03 ADJUSTING

A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.04 PROTECTION

A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.
   1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
   2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION 061800
SECTION 06 20 15 - EXTERIOR WOOD SIDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

2. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Cedar tongue and groove wood siding
   2. Exterior standing and running trim.

B. Related Requirements: Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.
   1. Division 06 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
   2. Division 07 "Fluid Applied Weather Barriers" for weather-resistive barriers and flexible flashing.
   3. Division 07 "Sheet Metal Flashing and Trim" for metal flashing and trim installed with siding.

1.03 DEFINITIONS

A. WRCLA - Western Red Cedar Lumber Association

B. NLGA - National Lumber Grades Authority

C. ALSC - American Lumber Standards Committee

D. WWPA - Western Wood Products Association

E. Clear Cedar Grade "A" (Architectural Grade) "CVG" - Most boards completely clear of knots, with max. of 1 small knot, 1" max, in 12' length average. Blended dark and light boards to create an even flow, no dark boards among all light boards.

F. Near Clear Cedar Grade "B" - Most boards completely clear of knots, with max. of 3 small knot, 1 1/2" max, in 12' length average.

1.04 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. Retain "Samples for Initial Selection" or "Samples for Verification" Paragraphs below, or both.

B. Samples for Initial Selection: Provide manufacturer's standard stain color options for each type of siding product with factory-applied finishes.

C. Samples for Verification: For the following products, of sizes indicated, to verify color and finish selected.
   1. Lumber with or for transparent finish, provide a sample panel consisting of a minimum of four units high and 48" inches long, for each species and cut, demonstrating expected color variation.
1.05 INFORMATIONAL SUBMITTALS
   A. Qualification Statements: For Installer.
   B. Compliance Certificates:
      1. For lumber that is not marked with grade stamp.
   C. For preservative-treated wood that is not marked with treatment-quality mark. Sample warranties.

1.06 QUALITY ASSURANCE
   A. Qualifications:
      1. Mill/Supplier: WRCLA member
      2. Installers: WRCLA member
      3. Grading Agency: An independent testing and inspecting agency recognized by authorities having jurisdiction as qualified to label siding for compliance with referenced grading rules.
         a. NLGA - National Lumber Grades Authority
         b. CMSA - Canadian Mill Services Association

1.07 DELIVERY, STORAGE, AND HANDLING
   A. Store siding in a dry, well-ventilated, weathertight location in accordance with manufacturer's written instructions.
   B. Protect materials against weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation within and around stacks and under temporary coverings.
   C. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.
      1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
      2. Provide for air circulation around stacks and under coverings.

1.08 FIELD CONDITIONS
   A. Environmental Limitations: Proceed with installation only when existing and forecasted weather conditions permit siding installation and related Work to be performed in accordance with manufacturer's written instructions and warranty requirements.

1.09 WARRANTY
   A. Manufacturer's Warranty for Engineered Wood Siding Soffits and Trim: Manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
      1. Failures include, but are not limited to, deformation or deterioration beyond normal weathering.
      2. Warranty Period for Factory-Applied Finish: Five years from date of Substantial Completion.
   B. Installer's Warranty: The Installer warrants that wood siding materials and system installation will be free from defects in workmanship for a period of one year from the date of substantial completion. Installer will correct all defects due to faulty installation that appear within the warranty period, at no cost to Owner. Warranty shall cover all cost for material and labor to make corrections.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Obtain each type of product from single source from single manufacturer.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Buffalo Lumber Company
   2. Terminal Forest Products
   3. Redwoods, Inc.

2.02 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC’s Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
   2. For exposed lumber, mark grade stamp on end or back of each piece.

2.03 MATERIALS

A. Cedar Siding: Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA
   1. Grade: A Clear and Better.
   2. Size: 8" Tongue and Groove
   3. Board Thickness: 1"  
   4. Profile: Tongue and Groove V2E
   5. Texture: Smooth Face
   6. Pattern: Horizontal
   7. Moisture Content: Kiln-dried to 12% before factory machine applied stain finish
   8. Finish: Factory primed with machine applied exterior oil based wood stain / sealer all six sides.
   9. Fastening: Blind Nail
   10. Miter all outside corners. Clear Cedar Trim

B. Cedar Trim: Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA
   1. Grade: A Clear and Better.
   2. Size: as indicated on drawings
   3. Texture: Smooth Face.
   4. Moisture Content: Kiln-dried to 12% before factory machine applied stain finish
   5. Finish: Factory primed with machine applied exterior oil based wood stain / sealer all six sides.

2.04 ACCESSORIES

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1 inch
   1. Stainless steel ring shank nails with 1/4" inch head and blunt points to reduce splitting. into wood substrate.

B. Caulking: High-grade, non-hardening acrylic or equal.

C. Flashing: Comply with requirements in Division 07 "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.

PART 3 - EXECUTION

3.01 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. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.02 INSTALLATION GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
   1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
   1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
   2. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
   3. Coordinate exterior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.
   4. Miter trim and siding corners

3.03 TRIM INSTALLATION

A. Install trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long except where necessary.
   1. Use scarf joints for end-to-end joints.
   2. Stagger end joints in adjacent and related members.

B. Fit exterior joints to exclude water. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

C. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.04 SIDING INSTALLATION

A. Install siding to comply with manufacturer's written instructions.

B. Horizontal Lumber Siding:
   1. Apply starter strip along bottom edge of sheathing or sill.
   2. Install first course of siding, with lower edge at least 1/8 inch (3 mm) below starter strip and subsequent courses lapped 1 inch (25 mm) over course below.
      a. Nail at each stud.
      b. Do not allow nails to penetrate more than one thickness of siding.
   3. Leave 1/8-inch (3-mm) gap at trim and corners unless otherwise recommended by manufacturer, and apply sealant.
   4. Butt joints only over framing or blocking, nailing top and bottom on each side and staggering joints in subsequent courses.
   5. Install prefabricated outside corners as recommended by manufacturer of siding materials.
Flashing: Install metal flashing as indicated on Drawings.

3.05 ADJUSTING
A. Replace exterior finish carpentry that is damaged or does not comply with requirements.
   1. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.
B. Adjust joinery for uniform appearance.

3.06 CLEANING
A. Clean exterior finish carpentry on exposed and semi exposed surfaces.
B. Touch up factory-applied finishes to restore damaged or soiled areas.

3.07 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 06 20 15
SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. This Section includes the following:
   1. Interior frames and jambs.
   2. Wood cabinets.
   3. Wood base trim
   4. Solid surface - Quartz countertops.
   5. Closet and utility wood shelving.

B. Related Sections include the following:
   1. Division 05 Section - Metal Fabrications for metal railings, handrail brackets and miscellaneous steel as required to support countertops.
   2. Division 06 Section - Rough Carpentry for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
   3. Division 07 Section - Joint Sealants for sealing around architectural woodwork and countertops.
   4. Division 09 Section - Painting for field finishing of architectural woodwork.
   5. Division 11 Section - Residential Appliances for appliances installed in millwork and under countertops.
   6. Division 22 Sections for plumbing fixtures and fittings.
   7. Division 26 Sections for electrical devices installed in architectural woodwork.

1.03 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

B. Transparent Finish: Wood finish with exposed grain, including both stained and unstained finishes in colors as selected by Architect, with clear or translucent protective finish coat(s).

C. Opaque Finish: Coating finish systems that completely obscure the wood grain.

1.04 COORDINATION

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

B. For appliances, equipment, electrical/plumbing fixtures and utilities attached to or adjacent prior to installation of cabinets. to millwork, coordinate required clearances and rough openings, prior to fabrication and
1. Prior to fabrication of millwork, Contractor to verify that appliance doors, handles, and controls do not conflict with doors and drawers of adjacent millwork, and adjust millwork dimensions or provide filler strips as required to allow full 90° opening of all doors, and full opening of drawers. Coordinate prior to utility rough in where solution involves changing the location of appliances.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including cabinet hardware and accessories and finishing materials and processes.
   1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   2. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers and other items installed in architectural woodwork.
   3. Show arrangement of splashes at countertops.

C. Samples for Verification:
   1. Lumber with or for transparent finish, not less than 5 inches wide by 12 inches long, for each species and cut, finished on 1 side and 1 edge.
   2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
   3. Veneer-faced panel products with or for transparent finish, 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.
   4. Lumber and panel products with shop-applied finish, 50 sq. in. for lumber and 6 by 8 inches for panels, for each finish system and color, with exposed surface finished.
   5. Corner pieces as follows:
      a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
      b. Miter joints for standing trim.
   6. Exposed cabinet hardware and accessories, one unit for each type.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of product, signed by product manufacturer.

C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.07 QUALITY ASSURANCE

A. Materials and Fabrication, General:
   1. Provide Custom Grade for transparent (stained) finish, per AWI standards. Casework and Cabinetry shall be of reveal overlay design, unless otherwise specified or indicated on drawings.
   2. Casework shall minimally meet AWI Section 400A standards for transparent finished custom grade casework.
   3. All dimensions, substrates, etc. shall be verified in the field by the Contractor.
   4. Use maximum length material for all trim, base, etc.
   5. Scribe and fit all cabinets and casework tightly to adjoining construction unless otherwise indicated.
B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
   1. Fabricator shall have had at least 5 years experience in projects of similar scope.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers and transparent-finished wood doors that are required to be of same species as woodwork.

D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
   1. Provide AWI Quality Certification Program labels and certificates indicating that woodwork complies with requirements of grades specified.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section - Project Management and Coordination.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.09 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and maintaining relative humidity within typical design operating range for the facility, during the remainder of the construction period.

C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
   2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.
1.10 COORDINATION
A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

B. For appliances and equipment attached to or adjacent to millwork, coordinate required clearances and rough openings, prior to fabrication and prior to installation of cabinets.
   1. Prior to fabrication of millwork, Contractor to verify that appliance doors, handles, and controls do not conflict with doors and drawers of adjacent millwork, and adjust millwork dimensions or provide filler strips as required to allow full 90° opening of all doors, and full opening of drawers. Coordinate prior to utility rough in where solution involves changing the location of appliances.

1.11 WARRANTIES
A. Quartz countertop manufacturer's standard 10-year warranty against material defects.

1.12 EXTRA MATERIALS
A. Provide additional shelf brackets for adjustable cabinet shelves, minimum of one additional bracket per cabinet section with adjustable shelves, in manufacturer’s unopened packages.

PART 2 - PRODUCTS
2.01 MATERIALS
A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Stained Finish: Mahogany, plain sawn.
   1. Stain Color: Color and process as required to match appearance of wood doors (as specified under Division 08 “Flush Wood Doors”).

C. Wood Products: Comply with the following:
   1. All lumber shall be kiln dried to a moisture content of 4-1/2 percent. Kiln dried lumber shall be tempered for not less than four weeks before using.
      a. Locations: At all non-wet areas.
      a. Species
         1) Douglas Fir
         2) Western Larch
      b. Locations: At all wet areas.
   5. Medium Density Fiberboard Combination Core Plywood: Panels constructed of veneer core plywood inner plies with phenolic-bonded MDF crossbands with PureBond® formaldehyde-free technology; Classic Core as manufactured by Columbia Forest Products, or approved equal.
      a. Use Combination Core panels at doors and drawer fronts and exposed end panels unless otherwise noted.
A. General:
   1. All hardware and accessory materials associated with architectural cabinets provided and installed by cabinet fabricator.
   2. Finish for Exposed Cabinet Hardware (Typical unless otherwise noted): as selected by Architect from Manufacturer’s available finishes.
   3. Finish for Semi-Exposed and Concealed Cabinet Hardware (Typical unless otherwise noted): as selected by Architect from Manufacturer’s available finishes.
   4. Provide all screws, fasteners, and miscellaneous hardware and attachments as required for complete installation.

B. Hinges:
   1. Butt Hinges: 2-3/4-inch, 5-knuckle steel hinges made from 0.095-inch thick metal.
      a. Provide hinges designed for thick doors where thick or hollow core doors are detailed in Drawings.
   2. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
      a. Provide four (4) hinges per leaf at tall cabinet doors.
      b. Provide hinges designed for thick doors, where thick or hollow core doors are detailed in Drawings.
      c. At combination core plywood, provide hinges with screws of the optimal length to make best advantage of screw pulling strength of the plywood core, regardless of whether the optimal screw length comes standard with the hinges.
      d. Where doors swing to adjacent walls, provide 90-100 degree of opening hinges adjustable to prevent doors from hitting walls, or provide wall stops as required to prevent damage to wall finishes.

C. Cabinet Pulls:
   1. Wire Pulls: Back mounted, solid metal, 5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter.
   2. Bar Pulls: Satin stainless steel bar pulls, 6 inches long, 4 inch centers, minimum of 3/8 inch in diameter and 1-1/4 inches deep, equal to Swiss Kelly SK-0006.

D. Adjustable Shelf Pilasters and Supports in Cabinets: Four Flush-mounted 23 gauge high strength steel, zinc finish pilaster standards adjustable to 1/2" increments, equal to Knape and Vogt Series 244.
   1. Provide an additional surface mounted Pilaster at all shelves wider than 36", at the middle back of shelf, equal to Knape and Vogt Series 233.
   2. Provide longest possible standards to fit full height of cabinets, using manufacturer’s standard lengths.
   3. Provide square, self-adhesive flat top clear rubber.
   4. Provide all installation hardware, and support brackets equal to Knape and Vogt 237 series, as required for complete installation. Provide additional support brackets as specified in Part 1 of these specifications.

E. Adjustable Shelf Rests (for pre-drilled holes at cabinet side supports):
   1. 1/4" diameter metal flat top shelf rests, equal to Knape and Vogt 331 series. Mortise bottom side of shelves to match shelf rest shape to prevent sliding.
   2. 1/4" diameter plastic type with shelf retention clip for 3/4" thick shelves, equal to Knape and Vogt 339 series.
   3. Provide additional shelf rests as specified in Part 1 of these specifications.

F. Drawer Slides: Zinc-plated steel drawer slides with steel ball bearings and as follows:
   1. Box Drawer Slides (for drawers less than 7" deep): Side mounted; full-extension type; Medium duty, 100 lb rated.
a. Typical Box Drawer Soft closing slides equal to Fulterer 5001.ECD series.
2. File Drawer and Deep Storage Drawer Slides: Side mounted full-extension type; Heavy duty ball bearing, 200 lb rated.

G. Grommets for Cable Passage through Countertops: 3-inch, color as selected by Architect from manufacturer’s full range, molded-plastic grommets and matching plastic caps with slot for wire passage.
1. Product: Subject to compliance with requirements, provide "XG series" by Doug Mockett & Company, Inc.

H. Adjustable Storage Shelving on Standards:
1. Double slotted heavy duty standards and brackets with white finish shall be Knape and Vogt No. E85 and E185, or approved equal.
2. Shelves shall be 3/4" painted hardwood plywood unless otherwise noted.
3. Attach shelves to brackets with screws.

I. Floating Countertop support brackets: 18” steel brackets, sizes as required for cantilever dimensions and spacing as indicated in Drawings, equal to brackets as manufactured by A&M Hardware, Inc. (www.aandmhardware.com); or comparable products by another Manufacturer.
2. Provide additional 2x wood blocking in wall as required for stud stiffening and attachment.
3. Space brackets as required to meet load ratings, and not further apart than span capability of the countertop or shelf construction being supported.

J. Silencers: 1/8" domed clear rubber self-adhesive pads. Install two per cabinet drawer or door.

2.03 MISCELLANEOUS MATERIALS

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

B. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

C. Adhesives, General: Adhesives shall not contain urea formaldehyde.

2.04 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.

B. Solid Stock Standing and Running Trim
1. Species for Transparent Finish: Match species and grain of adjacent panels for transparent finish unless otherwise indicated.
2. Species for Opaque Finish: Any closed grain hardwood.
3. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

C. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

D. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

E. Cabinet Construction
1. Exposed Ends: Not less than 3/4" thick combination core plywood, connected to stile with pressure-glued tongue and plow joint and supplemented by special fasteners.
a. Ends at openings below countertops without adjacent base cabinet: 4” wide panel with 3/4" thick MDF (or 3/4" combination core MDF/plywood if screws are attached) on each side, and 1/4” cap at exposed end. Finished to match adjacent millwork. 4” dimension is to assist in rubber base wrapping around without puckering.

b. Provide finished backs, sides, and similar surfaces to match other exposed faces wherever exposed in the final work, and whether or not these exposed conditions are specifically indicated in the Drawings. Modify typical details as may be required to provide finished back, side and other panels that are not exposed in the typical conditions for each piece of millwork. Panel construction of such exposed panels shall be not less than that for other exposed panels.

c. 3/4" MDF is acceptable in lieu of combination core where there are no hinges attached to the panel.


3. Unexposed Ends: Not less than 1/2" thick plywood attached to front frame in same manner as exposed ends.
   a. 3/4" MDF is acceptable in lieu of combination core where there are no hinges attached to the panel.

4. Door and Drawer Faces: 3/4" thick combination core plywood.

5. Back, Top and Bottom Rails: Not less than 3/4" x 3" solid lumber machined to interlock with end panels, and grooved to receive top and bottom panels with back rails secured under pressure with glue and fastening devices.

6. Shelving: Not less than 3/4" thick hardwood plywood with louver core banded on front with 3/4" x 1-1/4" hardwood.

7. Bottoms: Not less than 3/4" thick plywood fully supported into gains in end panels and grooves in front and back bottom rails.

8. Back Panels: Not less than 1/4" thick, 5-ply veneer core plywood, glued and fastened to machined rear edge of end panels and to top and bottom rails.
   a. At exposed back panels, provide panels equal to those for exposed end panels and exposed surfaces shall match adjacent cabinet body finish.

9. Toe Boards: Not less than 3/8" attached between end panels and extended from bottom panel to floor.

10. Corner Blocks: Wood blocks glued and fastened in each of four top corners to maintain cabinet squareness and rigidity.

11. Casework Doors: 3/4 inch thick hardwood veneer combination core plywood with 1/4" hardwood banded edges.

F. Drawer Construction
   1. Drawer Body: Not less than 7/16" plywood sub-front, back and sides, fully dovetailed and glued at all four corners with fronts fastened to sub-front with mounting screws from interior of body.
   2. Drawer Bottoms: Not less than 1/4" thick 5-ply veneer core plywood glued into and fully supported by grooves in all four sides of drawer body.

G. Wall cabinets
   1. Valances: Provide continuous valance across each run of cabinets, with minimum number of joints required in each run. Locate joints to be hidden with doors in closed position.
      a. Set valance back slightly from face of cabinet frame to avoid contact with doors.
      b. Unless otherwise indicated, provide nominal 2” valance measured from top side of the bottom shelf to bottom of valance at typical cabinets and nominal 3” valance where below cabinet lighting is indicated.
   2. Doors: Fabricate doors to extend to 1/8” below bottom of valances, to allow for adjustment and hide the sight line of valances with doors in closed position.
   3. Exposed side panels: Extend down to match bottom of valance.
4. Finishes at Tops and Bottoms:
   a. Exposed finishes are also acceptable as long as consistently applied within any room or space.

H. Exposed surfaces shall be machine-sanded to an even, smooth surface, nails set, ready for finishing. All woodwork shall be dry, clean and smooth before any finishing materials are applied. All nail holes, cuts, cracks and other defects shall be treated so as to render them unnoticeable.

I. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

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

K. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   1. Seal edges of openings in countertops with a coat of varnish.
   2. Coordinate with actual appliances and equipment to be mounted to cabinets and under countertops, whether such equipment is provided by Contractor or by Owner, and verify unobstructed operation of equipment and of cabinet doors and drawers.

L. Countertops and Splashes:
   1. Units fabricated and designed to withstand a 200 lb. per sq. ft. loading condition without the use of vertical supports. Fabricator shall indicate on shop drawings any special locations for stud supports as required for attachment of countertops.
   2. Provide welded steel tube support frames to support countertops at wide spans between base cabinets, walls, or other countertop supports. Conceal steel tubes in adjacent wall, countertop, and cabinet construction to maximum extent possible unless specifically detailed otherwise. Refer to Division 5, Section - Metal Fabrications for general requirements. Provide steel supports as follows:
      a. Where specifically detailed in Drawings.
      b. Where required to achieve loading criteria specified.
   3. Junction between countertops and non-integral splashes caulked with clear silicone sealant providing a tight sanitary joint. Junction between splash, countertop or any casework and wall shall be caulked with silicone sealant of color to match wall or adjacent construction.
   4. Splash of same construction and countertop, to dimensions indicated on drawings. Provide side splashes at all walls and tall cabinets adjacent to countertops.

M. Install glass to comply with applicable requirements in Division 08 Section - Glazing and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.05 WOOD CABINETS FOR TRANSPARENT FINISH

A. Grade: Custom.
B. AWI Type of Cabinet Construction: Flush overlay.
C. Reveal Dimension: 1/4 inch.
D. Matching of Veneer Leaves: Book match.
E. Exposed Surfaces: Do not juxtapose materials noticeably dissimilar in color, grain, figure and natural color markings. Exposed portions of cabinets include all surfaces, including edges, visible when doors and drawers are closed. Visible surfaces in open cabinets and shelving units are also to be considered exposed surfaces. Provide materials as indicated below:
1. Doors and Drawer Fronts: 3/4” Panels of Hardwood Veneer on Combination Core Plywood, with hardwood banded edges.
2. Other Panel Surfaces: Hardwood veneer plywood.

F. Semi-exposed Surfaces: Transparent wood finish materials selected to eliminate appearance defects of any species of hardwood or softwood with color and grain characteristics similar to exposed portions. Semi-exposed portions of cabinets include surfaces behind opaque doors and drawer fronts including shelves, dividers, interior faces of cabinet ends, backs, tops and bottoms, drawer sides, backs and bottoms. Also, included are underside bottoms of cabinets over 2'-0" from floor and tops 5'-9" or more above floor. Provide surface materials indicated below:
1. Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.
2. Drawer Sides and Backs: Solid-hardwood lumber, stained to match species indicated for exposed surfaces.
3. Drawer Bottoms: Hardwood plywood.

G. Concealed Members: Solid Lumber. Concealed portions of cabinets include sleepers, web frames, dust panels and other surfaces not normally visible after installation.

2.06 QUARTZ SOLID SURFACE COUNTERTOPS
A. Solid-Surfacing-Material Thickness: 3/4 inch, with 3/4" splashes at countertop.
B. Edge Profiles:
   1. Countertops: Double layer with 1” projected edge. Profiles shall be Beveled at perimeter top side of open countertop (with micro-bevel at underside of countertop overhang).
C. Wood Underlayment Material (where required for support by surface material):
   1. Core Material at countertops: Medium-density fiberboard.
D. Colors, Patterns, and Finishes: As indicated in Drawings.
E. Accessories:
   1. Adhesive: Highest quality type as recommended by Quartz manufacturer.
   2. Joint Sealer: As recommended by Quartz manufacturer.
F. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
   1. Fabricate tops with shop-applied edges of materials and configuration indicated in Drawings.
   2. Fabricate with hairline joints.
   3. Cut holes for sinks and accessories as required.

2.07 WOOD BASE TRIM
A. Wood Floor Base Trim Material: Mahogany, plain sawn - 3/4-inch x 4-inch tall with transparent finish.

2.08 CLOSET AND UTILITY SHELVING
A. Shelf Material: 3/4-inch hardwood veneer-faced plywood with solid-lumber edge, for transparent finish.
2.09 SHOP FINISHING
A. Grade: Provide finishes of same grades as items to be finished.
B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
   1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with balancing sheet.
D. Stain Finish:
   1. Staining: Color and process as required to match appearance of wood doors (as specified under Division 08 “Flush Wood Doors”).
   2. AWI Finish System: Conversion varnish, unless otherwise noted.

PART 3 - EXECUTION
3.01 COORDINATION
A. Coordinate fully with work of related trades for piping, conduit, outlets, switches, plumbing fixtures, equipment, appliances, and other items installed into or adjacent to millwork cabinets, as required to avoid conflicts. Contractor shall make adjustments to millwork or other construction, at no additional cost to Owner, that may be required due to Contractor’s failure to coordinate between trades.

3.02 PREPARATION
A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing materials and backpriming.

3.03 INSTALLATION
A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Where exposed fastening is unavoidable, use fine finishing nails, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
3. Caulk space between backsplash and wall with sealant specified in Division 07 Section - Joint Sealants.

H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.04 ADJUSTING AND CLEANING

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

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 40 23
SECTION 06 64 00 - PLASTIC PANELING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Provide fiber reinforced plastic wall panels and trim accessories, as shown on the drawings and as herein specified.

B. Related Sections include the following:
   1. Division 09 Section - Gypsum Wallboard.
   2. Division 10 Section - Wall and Door Protection for corner guards over paneling.

1.03 PRODUCT DELIVERY STORAGE AND HANDLING

A. Deliver materials in manufacturer's original packaging. Remove from shipping skid and restack on a solid, flat, dry surface a minimum of 24 hours prior to installation. Do not stack panels directly on concrete floor.

B. Inspect panels for defects or unacceptable quality. Remove these items from premises.

1.04 SUBMITTALS

A. Division 01 Section - Submittal Procedures: Procedures for submittals.

B. Submit product literature and manufacturer's standard brochures on all materials specified.

C. Submit 12" x 12" sample of each type of panel, 12" long samples of each type of moldings and sample of each fastener.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Fiber Reinforced Plastic Panel: Semi-rigid reinforced thermosetting polyester resin panel sheet. Panel shall be of Class A flame spread according to ASTM E 84, with uniform color throughout. Panel shall be 4' x 9' and minimally 3/32" thick. Panel shall be Marlite Brand FRP Panels or approved equal. Color as selected by Architect from manufacturer’s standard colors.

B. Moldings: One piece extruded moldings of polyvinyl chloride at divisions between panels, inside and outside corners and at panel ends. Color shall match panel.

C. Adhesive: High strength waterproof, solvent rubber based adhesive, specifically for use on FRP panels shall be "C-551 Adhesive" or approved equal.

D. Sealant: One part acetoxy, silicone rubber sealant shall be Kemlite's No. S255W, in color “White”, as acceptable to panel manufacturer.

PART 3 - EXECUTION
3.01 INSPECTION
A. Examine surfaces to receive FRP panels for defects or irregularities that would impair installation or transfer through panel surface.
B. Substrate surface must be dry and free of dirt, dust and grease.

3.02 INSTALLATION
A. Spread adhesive 1/4" deep over entire panel to achieve 100% coverage.
B. Set panel in position before adhesive skins over. Pull panel off wall to flash off solvents and then replace panel. Apply adequate uniform pressure to make full contact between panel and wall.
C. Install molding to substrate using coated lath nails allowing 1/8" clearance between panel and division bar molding and 1/4" clearance at ceiling and floor junctures for expansion and contraction. Apply bead of sealant on opening of molding to receive panel prior to insertion of panel. Clean excess sealant from panel.
D. All edges and joints of panels shall receive molding. Use continuous 10' lengths of molding at all panels. Piecing will not be acceptable.

3.03 CLEANING
A. Exposed surfaces of materials sponged and washed, removing all dirt, excess sealant and excess adhesive.
B. Remove all debris and scraps and leave entire area clean and in acceptable condition.

END OF SECTION 06 64 00
PART 1  GENERAL

1.1  SUMMARY

A. Section Includes:
   1. Cold fluid-applied polyurethane membrane waterproofing for below-grade walls.
   2. Drainage board.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2  REFERENCES

A. ASTM International (ASTM):

1.3  SUBMITTALS

A. Submittals for Review:
   1. Product Data: Manufacturer's data for waterproofing and drainage board including product description and performance characteristics.
   2. Samples: 3 x 3 inch waterproofing samples on representative backing.
   3. Warranty: Sample warranty form.

B. Quality Control Submittals:
   1. Applicator's license certificate issued by manufacturer of waterproofing material.

1.4  QUALITY ASSURANCE

A. Applicator Qualifications:
   1. Minimum 2 years experience in work of this Section.
   2. Licensed or certified by waterproofing manufacturer.

1.5  DELIVERY, STORAGE AND HANDLING

A. Store materials at minimum 75 degrees F; prevent damage to containers. Do not store in direct sunlight.

1.6  PROJECT CONDITIONS

A. Environmental Conditions:
   1. Do not apply waterproofing when ambient or surface temperature is less than 40 degrees F or if precipitation is imminent.
   2. Do not apply material to wet surfaces.
B. Substrate: Cured minimum 28 days prior to applying waterproofing.

1.7 WARRANTIES

A. Furnish manufacturer’s 5 year warranty providing coverage against water leakage through waterproofing system.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Kemper System America, Inc. (www.kemper-system.com)
   3. Tremco, Inc. (www.tremco.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Fluid Applied Waterproofing:
   1. Type: Single-component, bitumen modified, cold liquid applied moisture curing urethane complying with ASTM C836.
   2. Physical properties:
      a. Elongation: Minimum 600 percent, tested to ASTM D412.
      b. Tensile strength: Minimum 150 psi, tested to ASTM D412.
      c. 100 percent modulus: Minimum 80 psi, tested to ASTM D412.
      d. Crack bridging: Pass 1/16 inch with no loss of bond or cracking exhibited, cycled 10 times per 24 hours at 15 degrees F, tested to ASTM C836.
      e. Moisture vapor permeability: Maximum 0.1 perm, tested to ASTM E96.

B. Reinforcing Fabric: Waterproofing manufacturer's standard.

2.3 ACCESSORIES

A. Surface Conditioner, Joint Sealers, and Patching Compounds: Type recommended by waterproofing manufacturer.

B. Drainage Board:
   1. Studded, non-biodegradable, molded plastic sheet drainage core with nonwoven, needle-punched geotextile facing laminated to one side and polymeric film bonded to other side.
   2. Vertical flow rate: Minimum 9 gallons per minute per foot.
   3. Thickness: Nominally 1/4 inch.
   4. Adhesive: Type recommended by drainage board manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces; remove loose and foreign matter that could impede adhesion or performance of waterproofing.
B. Clean exposed metals; apply surface conditioner and coat of waterproofing material to minimum 60 mils thickness. Extend preparatory coat minimum 3 inches onto adjacent surfaces.

C. Clean cracks and joints in substrate less than 1/16 inch in width and apply preparatory coat of waterproofing material, minimum 60 mils wet film thickness; extend minimum 3 inches onto adjacent surfaces.

D. Rout out cracks and joints over 1/16 inch in width to minimum 1/4 inch depth, and fill with waterproofing. Apply preparatory coat of waterproofing material, minimum 60 mils wet film thickness; extend minimum 3 inches onto adjacent surfaces.

E. At changes in plane of substrate, form cant of waterproofing material, minimum 1 inch high.

F. Allow preparatory work to cure minimum 12 hours, then clean and apply surface conditioner.

3.2 APPLICATION OF WATERPROOFING

A. Apply waterproofing system in accordance with manufacturer’s instructions.

B. Apply in as many coats as needed to achieve minimum 60 mils wet film thickness, excluding preparatory work.

C. Seal items projecting through membrane.

D. Apply waterproofing with reinforcing fabric at locations of potential high movement, including intersections not structurally connected.

3.3 INSTALLATION OF DRAINAGE BOARD

A. Apply drainage board the same day membrane is applied.

B. Install in accordance with manufacturer's instructions.

C. Cut pieces from roll to required length. Cut to fit around penetrations and at perimeter.

D. Secure sheets to waterproofing membrane with adhesive. Place with filter fabric to earth.

E. Overlap and secure filter fabric on adjacent sheets.

F. Pull filter fabric loose from core at bottom of wall; wrap fabric around subsurface drainage pipe.

3.4 FIELD QUALITY CONTROL

A. Prior to applying drainage course, inspect surfaces for voids, ruptures, and other damage.

B. Repair damaged and defective areas.

END OF SECTION
SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Provide all building insulation as shown on the drawings and as herein specified.

B. Related Sections include the following:
   1. Division 06 Section - Sheathing.
   2. Division 07 Section - Air Barriers.
   3. Division 09 Section - Gypsum Board.
   4. Division 09 Section - Acoustic Insulation.
   5. Division 21 and 23 Sections, for piping and mechanical ductwork insulation.

1.03 QUALITY ASSURANCE

A. Design Criteria:
   1. Thermal Resistance: R-Value designations indicated in accordance with ASTM C-518 is the thermal resistance of the insulation only.
   2. Fire Resistance: Material shall have a Class B fire rating less than 75 as tested by ASTM E-84.

B. Paper faced batt insulation shall not be used. Foil-faced insulation shall not be used except as specifically prescribed herein.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original packages, clearly marked with brand name, type and R-Value.

B. Store materials in area protected from weather, moisture and damage, remove any damaged materials from the site.

1.05 SUBMITTALS

A. Samples of materials and complete product literature (with documented R-Values) submitted for approval to the Architect prior to ordering materials.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with project requirements, Manufacturer’s offering Products which may be incorporated into the work include the following:
   2. Owens-Corning Fiberglas Corporation, Toledo, OH. (419) 248-8000.
   4. Johns Manville, Denver, CO.
5. Knauf Insulation, Shelbyville, IN.
6. Dow Chemical Company, Midland, MI.
7. ROXUL, Inc., Milton, Ontario

B. Division 01 Section - Product Requirements: Product options and substitutions. Substitutions: Permitted.

2.02 MATERIALS

A. Mineral Batt Insulation: Unfaced, ASTM C 665, Type I; 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. Use mineral batts where insulation built into concealed cavities in framing may become wet prior to closing the building envelope.

1. Provide at 5 1/2" stud construction in exterior walls and between conditioned and unconditioned spaces, unless otherwise noted: Nominal 5 1/2" thick batt insulation with a minimum R-value of 21.

B. Continuous Insulation at exterior cavity at dry joint rain screen exterior finishes: High density, semi-rigid mineral wool insulation board that is water repellent and meets ASTM C612, IVA. Thermafiber RainBarrier HD Insulation, or approved equal.

1. R-Value: 4.3 per inch of thickness. Thickness(es) as noted on Drawings.
2. Facing: Unfaced.
3. Density: 6.0 pounds per cubic foot.
4. Surface Burning Characteristics: Flame Spread 0, Smoke Developed 0.
5. Moisture Resistance: Absorbs less than 0.03% by volume, ASTM C 1104.

C. Semi-Rigid Insulation above Ceilings where noted: Nominal 9-1/2" thick wool batt insulation with an R-Value of 38, unfaced. Material equivalent to ComfortBatt by Rockwool. Insulation shall comply with ASTM C 665-84, Type II, Class C.

D. Rigid Insulation Exterior Spandrel Glass: 2" fiberglass, RFK faced with minimum R-9 value. Insulation shall be Owens-Corning, U.S. Gypsum, or approved equal.

2.03 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates. Adhesive shall be compatible with air barrier membrane.

B. Provide insulation fasteners as recommended by manufacturer for substrates and conditions indicated.

C. Provide tape to seal joints between cavity insulation sheathing equal to X-Seal Tape as manufactured by Hohmann & Barnard, Inc..

D. Provide insulation netting to hold attic insulation in place between roof rafters equal to “Insulation Net” as manufactured by Industrial Netting.

PART 3 - EXECUTION

3.01 INSPECTION AND COORDINATION

A. Examine areas receiving insulation work to insure work of preceding trades is completed. Check surfaces to see that they are uniform in place, free from mortar droppings, grease, oil or other debris which would affect proper insulation. Application constitutes acceptance of substrate conditions.
B. Coordinate marking centerline of studs on exterior face of continuous insulation as required for insulation installation and for subsequent fastener installation by other trades.

3.02 GENERAL INSTALLATION

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

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

C. Insulation installed in accordance with current printed recommendations of insulation manufacturer as specified.

D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. Install batt insulation without visible voids, gaps or separations. Place insulation in Cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members. Cut and trim insulation neatly to fit spaces without laps, bulges or folds. Use batts free of rips and tears.
   1. Coordinate with light gauge metal stud installer to pack batt insulation in light gauge metal construction as it is being constructed, that will be inaccessible to install batts when completed (headers, stud packs, etc). Use mineral batts where insulation may get wet or be exposed to weather prior to closing the building envelope.

F. Fit insulation tight within spaces and tight to and behind mechanical and electrical wiring.

G. Mineral Fiber Semi-Rigid Board Continuous Insulation:
   1. Continuous insulation at exterior walls shall be adhered or attached in place per manufacturer's recommendations for the substrates and conditions indicated. Use of friction fit only between furring channels is not an acceptable installation.
   a. Construction adhesive must be recommended by its manufacturer for use with the continuous insulation board and compatible with air barrier membrane or dampproofing mastic with which it will come in contact.
   b. Mechanical fasteners installation shall be coordinated with air barrier manufacturer's requirements for fastener penetrations through the air barrier, as applicable.
   2. Fit courses of insulation with edges butted tightly in both directions. Press units firmly against substrates indicated.
   3. Press units firmly against sheathing, or other substrates. Stagger joints. Make insulation continuous. Fill all voids.
   4. Coordinate placement of insulation with location of masonry veneer anchors, metal Zee furring, and similar construction.
   5. Cut and fit insulation tight to protrusions or interruptions to insulation plane.

3.03 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Install batt insulation 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 cavity, 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. For wood-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

3.04 FIELD QUALITY CONTROL

A. Comply with requirements of Authorities having jurisdiction for inspection of installation of insulation, and with requirements of commissioning agent. Notify respective parties and schedule required inspections prior to closing walls or cavities containing thermal insulation.

END OF SECTION 07 21 00
SECTION 07 26 00 - VAPOR BARRIER MEMBRANE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section includes:
   1. Vapor barrier film beneath slabs on grade and slabs on void forms.

B. Related Sections:
   1. Division 03 Section - Cast-in-Place Concrete.
   2. Division 31 Section - Earthwork.

1.03 COORDINATION

A. Coordinate installation with scheduled concrete pours to avoid delays. Make provision for installation of work by other trades.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM E 1745-11 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
   2. ASTM E 154-08 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
   6. ASTM E 1643-11 Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

B. American Concrete Institute (ACI):
   1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

1.05 SUBMITTALS

A. Division 01 Section - Submittal Procedures: Procedures for submittals.

B. Quality Control / Assurance:
   1. Summary of test results as per paragraph 8.3 of ASTM E 1745.
   2. Manufacturer’s literature.
   3. Manufacturer’s installation instructions for placement, seaming and penetration repair.

C. Provide 12” x 12” samples of vapor barrier material and samples of tape for joints.
PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:

B. Division 01 Section - Product Requirements: Product options and substitutions.
   Substitutions: Not Permitted

2.02 MATERIALS

A. Membrane Film:
   1. Qualities:
      a. Maintain a permeance of less than 0.01 Perms [grains/(ft² \cdot hr \cdot inHg)], as tested in accordance ASTM E-154, with mandatory conditioning tests, per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
      b. Strength: ASTM E 1745 Class A.
      c. Thickness: 15 mils minimum, in accordance with ACI 302.2R-06.
      d. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1.
   2. Available products:
      b. Vapor Block (15 mil) by Raven Industries.
      c. VaporGuard (15 mil) by Reef Industries.
      d. No Substitutions.
   3. At crawl space application, use manufacturer's minimum 15 mil thickness crawl space rated product.

B. Accessories:
   1. Seams Tape: Stego Tape by Stego Industries LLC, or membrane manufacturer's standard tape for applications indicated.
   2. Penetration Repair: Stego Mastic and Stego Tape by Stego Industries LLC, or membrane manufacturer's standard product for applications indicated.
   3. Perimeter / Edge Seal: Crete Claw, Stego Tack Tape and Stego Term Bar by Stego Industries LLC, or membrane manufacturer's standard product for applications indicated.
   4. For crawl space installation, use pins, adhesives, double sided mounting tape, termination bars, and caulking as recommended by membrane manufacturer for the applications indicated.

PART 3 - EXECUTION

3.01 PREPARATION

A. Do not proceed until fill is level and without voids, and plumbing and electrical rough-ins are complete.

3.02 INSTALLATION - GENERAL

A. Install Vapor Barrier in accordance with ASTM E 1643-11:
   1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
2. Extend vapor barrier over footings and grade beams to a distance acceptable to the structural engineer or stop at impediments such as dowels and waterstops.
3. Seal vapor barrier to slab perimeter/edge using Stego Crete Claw and remove dirt, debris, and mud from Crete Claw prior to concrete placement.
4. Alternate: Seal vapor barrier to footing/grade beam with double sided tape, termination bar, or both.
5. Overlap joints 6 inches and seal with manufacturer’s tape.
6. Apply tape/Crete Claw to a clean and dry vapor barrier.
7. Seal all penetrations (including pipes) per manufacturer’s instructions.
8. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
9. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all sides with tape.

B. Vapor Barrier over void boxes:
   1. Cartons for slabs shall have protective cover board with Stego 15 mil and Stego Crete-Claw Tape.
   2. Stego Crete-Claw Tape Instructions: Overlap seams a minimum of 6 inches. Seal all seams in Stego Wrap using Crete-Claw Tape.
   3. Install Crete-Claw Tape on the entire perimeter of the Stego Wrap Installation.
   4. Install additional Crete-Claw Tape if required.

3.03 PROTECTION
   A. Protect completed membrane from damage. Prior to pouring concrete, inspect membrane for punctures or damage and repair as required.
      1. At crawl space applications, inspect membrane for damage prior to substantial completion. Repair damaged areas per membrane manufacturer’s instructions.

END OF SECTION 07 26 00
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. This Section includes the following:
   1. Fluid-applied, vapor permeable weather barrier membrane system for masonry veneer and closed face cladding systems.

B. Related Sections include the following:
   1. Division 04 and 07 Sections cladding system(s) installed in front of fluid applied air barrier.
   2. Division 06 for coordination with sheathing installation requirements.
   3. Division 07 Sections for coordination with other weatherization systems of the building envelope.
   4. Division 07 Section - Sheet Metal Flashing and Trim, for coordination of metal and composite flashing with air barrier systems.

1.03 REFERENCES


1.04 PERFORMANCE REQUIREMENTS
A. General: Air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation and water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Junctions of air barrier shall be coordinated with other adjacent weatherization systems for complete weather tight building envelope.

C. Entire system visible through open faced cladding system(s) shall be consistent uniform color.
   1. Color: Manufacturer’s standard.
   2. Visible surface shall be of consistent quality that in Architect's opinion does not adversely affect aesthetic quality of the installation, to quality standards as per approved mock-up.

1.05 ACTION SUBMITTALS
A. Product Data: For each product indicated
B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
   1. Include details of interfaces with other materials that form part of air barrier.

1.06 INFORMATIONAL SUBMITTALS
A. Product certificates.
B. Qualification data.
C. Product test reports.

1.07 QUALITY ASSURANCE
A. Applicator Qualifications: Submit document stating the applicator of the primary air barrier membranes specified in this section is qualified by the manufacturer as suitable for the execution of the Work.
B. Maintain a copy of manufacturer's written installation instructions on site. Allow access to work site by air barrier membrane manufacturer's representative to inspect installation.
C. Single Source Responsibility: Components used shall be sourced from one manufacturer, including sheet membrane, air barrier sealants, primers, mastics, and adhesives. Obtain air barrier materials from a single manufacturer regularly engaged in manufacturing the product.
D. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.
   1. Include junctions with roofing membrane and other adjacent weatherization systems as applicable.
E. Pre-installation Conference: Conduct a pre-installation conference, at least two weeks prior to start of any air barrier system or weatherization system installation. Attendees shall include Contractor, Architect, certified air barrier installer, installers of any other air barrier or weatherization systems, any other contractors responsible for any portion of the complete building Continuous Air Barrier system, air barrier manufacturer’s designated field representative, and installers of other work that interfaces with the Continuous Air Barrier system.
1. Review Contractor’s responsibility for a complete Continuous Air Barrier system for the entire building.
2. Review methods and procedures related to air and weather barrier system(s) installation, including manufacturer's written instructions.
3. Review submittals and any questions regarding Architect’s comments.
4. Review and finalize construction, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
5. Review air and weather barrier system(s) interface with flashings, special details, and condition of other construction that affects weather barrier.
6. Review details and requirements for sealing air barrier systems around penetrations such as pipes, ducts, electrical boxes, structural elements penetrating exterior walls, etc.
7. Review requirements for air barrier system(s) where cladding attachments, masonry ties, or other fasteners will penetrate the air barrier system(s).
8. Review materials and details for junctures between different air barrier or weatherization systems.
9. Review details for complete building Continuous Air Barrier system, including at top of wall to bottom of deck and any other details that might not part of any single air barrier or weatherization system’s standard installation details.
10. Review mockups (if mockups are already prepared), or requirements for mockups (if mockups are not yet prepared).
11. Review construction sequencing and other requirements for work interfacing with air and weather barrier system(s).
12. Review field testing requirements.
13. Review temporary protection requirements for air and weather barriers during and after installation.
14. Review proper procedures for repair of air and weather barrier systems.
15. Review weather barrier manufacturer's Project registration and observation process.

1.08 DELIVERY, STORAGE AND HANDLING

A. Refer to current Product MSDS for proper storage and handling. Store and handle materials in compliance with manufacturer's recommendations, and within manufacturer's temperature limits.
B. Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.
C. Store role materials on end in original packaging. Protect rolls from direct sunlight until ready for use.
D. Keep solvent away from open flame or excessive heat.

1.09 SCHEDULING

A. Review requirements for sequencing of installation of weather barrier system with installation of windows, doors, louvers and flashings to provide a weather-tight barrier system.
B. Schedule installation of exterior cladding within nine months of weather barrier system installation, or within Manufacturer's recommended duration for exposure to the elements and UV radiation, whichever is less.

1.10 WARRANTY

A. Manufacturer warranty program - The DuPont™ Tyvek® Fluid Applied WB+ offers a 10 Year Limited Product Warranty Program that is project specific and requires pre-installation meetings and jobsite observations by the manufacturer. To receive coverage under the
DuPont™ Tyvek® Fluid Applied WB+ Product 10 Year Limited Product Warranty Program, it is required the following conditions are met; use of manufacturer’s recommended installation methods, a DuPont™ Certified Installer, required mock-up and pre-construction meetings and observation visits during installation along with required submittal and post installation documentation process. Please refer to: www.weatherization.TYVEK.com for complete details on the DuPont™ Tyvek® Fluid Applied WB+ 10 Year Limited product warranty program.)

B. Limited Warranty
1. Manufacturer's warranty for weather barrier for a period of ten (10) years from date of Purchase.
2. Pre-installation meeting and jobsite observations by weather barrier manufacturer for warranty are required.
3. Warranty Areas: Entire area of fluid applied weather barrier.

PART 2 - PRODUCTS

2.01 FLUID-APPLIED MEMBRANE AIR BARRIER SYSTEM

A. Manufacturer: Basis of design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer: DuPont Building Innovations; 4417 Lancaster Pike, Chestnut Run Plaza 728, Wilmington, DE 19805; 1.800.44TYVEK (8-9835); http://weatherization.tyvek.com
1. Description: A single-component, low VOC, 25 mil thick synthetic polymer fluid-applied product with superior elasticity and flexibility providing resistance to air flow, bulk water and wind driven rain yet allows moisture vapor to escape.
   a. Include other accessories or products as required by manufacturer for specified warranty.

B. Performance Characteristics:
1. Air Penetration: 0.0002 cfm/ft² at 75 Pa, when tested in accordance with ASTM E 2178. Type I per ASTM E 1677 and ≤ 0.01 cfm/ft² at 75 Pa, when tested in accordance with ASTM E 2357.
2. Water Vapor Transmission: 22 perms, when tested in accordance with ASTM E 96, Method B at 25 mils DFT (Dry Film Thickness).
3. Water Penetration Resistance: Greater than 1000 cm when tested in accordance with AATCC Test Method 127. No leakage at 15 psf when tested in accordance with ASTM E 331.
4. Air Penetration Resistance: Air infiltration greater than 10,000 seconds per 100cc, when tested in accordance with TAPPI Test Method T-460.
5. Tensile Strength: Minimum 220 lbs/in², when tested in accordance with ASTM D 412.
7. Hardness: Passes at a Shore A hardness of 71, when tested in accordance with ASTM D 2240.
10. Volatile Organic Content (VOC): Less than 2% when measured in accordance with ASTM C 1250.
11. Adhesion Strength (Concrete): Greater than 33 psi when measured in accordance with ASTM D 4541.

2.02 ACCESSORIES

A. Joint Tape: Self-adhered fiberglass mesh tape as recommended by weather barrier manufacturer.

B. Flashing:
   1. Vapor permeable elastomeric flashing:
      a. Product: DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound+, and/or:
      b. Product: DuPont™ FlexWrap™ NF.
   2. Sheet flashing with butyl adhesive layer, for use at transitions between wall material, building corners, and over gaps in sheathing up to 1 inch wide:
   3. Thru-wall flashing:
      a. Refer to Division 4 "Unit Masonry" and Division 7 Section "Sheet Metal Flashing and Trim".
      b. Flexible membrane flashing with butyl adhesive layer: Product: DuPont™ Thru-Wall Flashing. Use only if and where not otherwise specified or detailed for metal flashings.

C. Joint Compound: Fluid-applied, vapor permeable, elastomeric flashing material; trowel applied.
   1. Product: DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound+.

D. Sealant: Elastomeric; non-vapor permeable sealant; compatible with weather barrier.

PART 3 - EXECUTION

3.01 EXAMINATION AND COORDINATION

A. Coordinate and schedule installation with other trades to install weather barrier prior to windows, doors, louvers and other openings, and to ensure maximum duration for exposure of the weather barrier to the elements is not exceeded.

B. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

C. Verify that surfaces and conditions are ready to accept the Work of this section. Commencement of the Work or any parts thereof shall constitute acceptance of the prepared substrates.

D. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints flush.

E. Where curing compounds are used they must be clear resin based without oil, wax or pigments.

F. Do not proceed with application of air barrier membrane when rain is expected within 24 hours.

G. Condition materials prior to application to room temperature, or as recommended by manufacturer, to facilitate handling.

3.02 SURFACE PREPARATION

A. Ensure all preparatory Work is complete prior to applying primary air barrier membrane.
B. Complete surface preparation, priming, flashing and detailing of openings, cracks, and material transitions prior to beginning installation of fluid-applied weather barrier system.

C. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing and fastened into solid backing.

3.03 INSTALLATION / DETAILING

A. Corners: Apply joint compound, 25 mil thick, to outside and inside corners. Joint compound shall extend 2 inches from corner for full height of corner; or: Apply primer to outside and inside corners, extend 2 inches on each side of corner. Center sheet flashing over corner and press firmly in place per manufacturer’s recommendations. Apply $\frac{1}{2}$ inch fillet bead of joint compound applied to full-height of inside corners.

B. Joint treatment:
   1. Sheathing:
      a. Joints shall be prepared per manufacturer’s approved joint treatment details.
      b. Apply joint tape as recommended by fluid-applied weather barrier manufacturer.
         1) No joint treatment required for joints up to 1/16 inch.
         2) Joints 1/16 to 1/4 inch: Joint compound applied to form a 1 inch width on each side of sheathing joint; smooth joint compound across sheathing joint. Thickness shall be 15 to 25 mils.
         3) Joints 1/16 to 1/2 inch: Apply joint tape to bridge both sides of joint equally. Apply joint compound and trowel smooth embedding joint compound uniformly into joint tape to form a 1 inch width on each side of sheathing joint at a consistent thickness of 15 to 25 mils.
         4) Joints 1/2 to 1 inch: Apply sheet flashing primer above and below sheathing joint. Center sheet flashing over sheathing joint and press firmly in place per manufacturer’s recommendations.
   2. Non-movement joints in masonry and transitions to columns and beams:
      a. Joints 1/4 inch wide or less: Apply joint compound a minimum of 2 inches wide by 60 mils thick to each side of joint or crack.
      b. Joints 1/4 to 1/2 inch: Apply primer 2 inches on each side of joint. Center sheet flashing over joint and press firmly in place per manufacturer’s recommendations.
   C. Apply joint compound to cladding anchors prior to installation of weather barrier membrane per manufacturer's instructions.
   D. Apply joint compound around penetrations in exterior walls forming a fillet bead minimum $\frac{1}{2}$ inch onto each surface.
   E. Installation - Flexible flashing at openings:
      2. Cover horizontal sill by aligning sheet membrane edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure sheet membrane tightly into corners by working in along the sill before adhering up the jambs.
      5. Install sheet membrane at opening head using same installation procedures used at sill. Overlap jamb flashing a minimum of 2 inches.
Primary Seal Jamb Flashing at Metal Jamb Flashing: After installation of metal jamb flashing, apply liquid membrane over joint between exterior sheathing and jamb flashing, extending at least 3" onto each, and completely covering fasteners.

6. Coordinate flashing with fluid-applied weather barrier and window installation.

F. Allow Flashing, Joint Compound and Sealant to cure for minimum 24 hours before coating with Fluid-applied Weather Barrier.

3.04 INSTALLATION - FLUID-APPLIED WEATHER BARRIER

A. Install fluid-applied weather barrier prior to installation of windows, doors, and louvers.
B. Mask and protect any adjacent finished surfaces from fluid-applied weather barrier material.
C. Install fluid-applied weather barrier over exterior face of required exterior wall substrates in accordance with weather barrier manufacturer recommendations and instructions.
D. Install fluid-applied weather barrier by pressure rolling or spray and backroll method as approved by manufacturer to achieve 25 mils providing a consistent and uniform thickness.
E. Repair any voids, holidays, or non-uniform installations or damage by other trades to proper mil thickness prior to installation of final cladding assemblies.

3.05 FIELD QUALITY CONTROL

A. Notify weather barrier manufacturer's designated representative to obtain required periodic observations of weather barrier system installation.
B. Inspections: Weather barrier materials, accessories, and installation are subject to inspection by Manufacturer and Owner for compliance with performance requirements.
C. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
   1. Tests: As determined by Owner's testing agency from among the following tests:
      c. Qualitative Water-Leakage Testing: Weather barrier assemblies tested for water leakage according to ASTM E 1105.
D. Weather barriers assemblies will be considered defective upon failure of inspections and specific project testing required.
   1. Apply additional fluid-applied weather barrier material, in accordance with manufacturer's instructions, where inspection results indicate insufficient thickness, voids, skips, pinholes or other defects as recommended by weather barrier manufacturer.
   2. Remove and replace deficient weather barrier system components for retesting as specified above. Contractor shall be responsible to pay for re-testing of assemblies failing the initial tests.
E. Repair damage to weather barriers caused by destructive testing; follow manufacturer's written instructions.
3.06 PROTECTION AND CLEANING

A. Protect weather barrier from contact with incompatible materials and sealants not approved per weather barrier manufacturer's recommendation.

B. Protect installed weather barrier system from damage during construction prior to cladding installation.
   1. If damaged or exposed to UV beyond nine (9) months (or beyond Manufacturer's maximum exposure duration), clean and prepare surfaces and install additional, full-thickness, fluid-applied weather barrier application in accordance with weather barrier manufacturer's instructions.

C. Remove masking materials and adjacent protection after weather barrier installation.

END OF SECTION 07 27 26
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Work includes all labor, materials, equipment and services necessary for fabrication and installation and/or replacement of metal wall panels, aluminum battens and metal patches as shown on drawings and as herein specified.

B. Related Sections include the following:
   1. Division 05 Section – Metal Fabrications
   2. Division 06 Section – Rough Carpentry
   3. Division 06 Section - Sheathing
   4. Division 07 Section - Sheet Metal Flashing and Trim.
   5. Division 07 Section - Roof Accessories.
   6. Division 07 Section - Joint Sealant.

1.03 REFERENCE STANDARDS

A. References in these specifications to standards, test methods and codes, are implied to mean the latest edition of each such standard adopted. The following is an abbreviated list of associations, institutions, and societies which may be used as references throughout these specifications.

2. FM - Factory Mutual Engineering and Research, Norwood, MA.
3. NRCA - National Roofing Contractors Association, Rosemont, IL.
4. OSHA - Occupational Safety and Health Administration, Washington, DC.
5. SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Chantilly, VA
6. UL - Underwriters Laboratories, Northbook, IL

1.04 QUALITY ASSURANCE

A. Fabricator and erector shall demonstrate experience of a minimum of five years of related industry experience.

B. Design Criteria: Engineering panels for structural properties in accordance with the latest edition of the American Iron and Steel Institute "Cold Formed Steel Design Manual", using "effective width" concepts.

C. Metal Shapes Design Criteria: Conform to latest edition of Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

D. Preliminary Roofing Conference: Before starting roof construction, conduct conference at Project site.
   1. Review structural loading limitations of deck and structural members during and after roofing.
2. Review flashings including all penetration details, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
3. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
4. Review temporary protection requirements for metal panel systems during and after installation.
5. Review procedures for repair of metal panels damaged after installation.

1.05 PERFORMANCE REQUIREMENTS
A. General: Provide metal roof panel system meeting performance requirements as determined by application of specified tests by a qualified testing facility on manufacturer's standard assemblies.
B. Testing Requirements: The roof system shall be tested in compliance with local code requirements and as follows:
1. Wind Resistance: Through-fastened roof panel systems tested in compliance with UL 580 or UL 1897. Standing seam attached systems tested in compliance with UL 580 or ASTM E 1592.
2. Physical Weathering Properties: The system shall be tested to demonstrate physical integrity over the working life of the roof based upon 2,000 hours of exposure to accelerated weathering tests conducted in accordance with ASTM G152, ASTM G154, or ASTM G155.
   a. Corrosion Resistance: Metal panels shall have corrosion resistance in accordance with local code requirements for the materials indicated.
3. Impact Resistance: The system shall be tested to resist impact damage based on the results of tests conducted in accordance with ASTM D3746, ASTM D4272, CGSB 37-GP-52M, or the "Resistance to Foot Traffic Test" in Section 5.5 of FM 4470.
4. Fire Classification: The system shall be identified and listed for the fire class as required by local code by an approved testing agency, tested in compliance with ASTM E 108 or UL 790.
C. Structural Performance: Provide roof panels systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
   1. Wind Loads: As required by code and indicated wind rating, whichever is greater.
   2. Other Design Loads: As indicated on Drawings.
   3. Deflection Limits: For wind loads, no greater than 1/240.
D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
E. Air Infiltration, ASTM E 1680: Maximum 0.25 cfm/sq. ft. at static-air-pressure difference of 6.24 lbf/sq. ft.
F. Water Penetration Static Pressure, ASTM E 1646: No uncontrolled water penetration at a static pressure of 12 lbf/sq. ft.
G. Thermal Performance: Solar Reflectance Index shell be not less than 29 when calculated according to ASTM E 1980 based on tested 3-year aged solar reflectance and thermal emittance.
H. 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 ambient; 180 deg F material surfaces.
I. Jobsite Safety: Execute all operations and provide a safe work environment in accordance with OSHA standards and regulations.
   1. Follow all industry, code, fire prevention guidelines and requirements for storage of materials, staging areas, roof access, and application means and methods.

1.06 SUBMITTALS
A. Product data and shop drawings based on the Contract Documents and field conditions of each metal panel type, profile and trim configuration to be replaced and/or installed.
B. Samples:
   1. Submit six inch long samples of each metal wall component and trim.
   2. Submit samples of each type of sealant.
C. Shop drawings showing profile and gauge of sheets, location and type of fasteners, location, gauges, shape and method of attachment of all trim, location and type of sealants, and any other details as may be required for a weathertight installation. Indicate field and factory applied sealant.
D. Informational Submittal: Letter from Manufacturer stating acceptance of proposed underlayment for use with their products.

1.07 STORAGE AND HANDLING
A. Panels should be stored on edge in a clean dry place. One end should be slightly elevated to allow moisture to run off rather than accumulate on the faces.
B. Panels with strippable plastic film must not be stored in the open, exposed to the sun.
C. Stack pre-formed and prefinished material to prevent twisting, bending, or abrasion and to provide ventilation.
D. Prevent contact with materials during storage which may cause discoloration or staining.
E. In handling prefinished panels, lift up panels and do not slide panels when un-stacking.

1.08 FIELD CONDITIONS AND COORDINATION
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.
B. Coordinate sizes and locations of roof curbs, equipment supports, and other roof penetrations with actual equipment to be provided.
C. 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.

1.09 WARRANTY
A. Provide manufacturer's standard twenty (20) year warranty stating architectural fluorocarbon finish will be:
   1. Free of fading of color change in excess of 6 NBS units as measured per ASTM D 2244-68;
   2. Will not chalk in excess of numerical rating of 7 when measured in accordance with standard procedures specified in ASTM D 659-74;
   3. Will not peel, crack, chip, or de-laminate.
B. Furnish written warranty signed by applicator for two year period from date of substantial completion of building covering repairs required to maintain roof and flashings in watertight conditions.
C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace 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

2.01 MATERIALS

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. Solar Reflectance Index: Provide roof panels with an aged Solar Reflectance Index of not less than 0.65 when tested according to CRRC-1.

C. Metal Roofing Panels: 24 Gauge, 12" x 1" smooth face, interlocking, Galvalume steel panel with concealed fastening system and high grade hot melt elastomeric sealant to seal adjoining panel legs. Fascia and gutter shall be pre-formed, custom design as shown on drawings, fabricated of same material as panel. Panel shall be Berridge "Tee-Panel", with Signature 300 (Kynar 500) "Cool Roof" 70% PVDF fluoropolymer resin coating in color as selected by Architect from Manufacturer's standard range, or approved equal. Minimum .65 SRI for low-slope roof (2:12 or less). MBCI "BattenLock HS" standing seam metal roofing panels, or Centurion Industries "A-Lert KR Roof System" shall be acceptable products.
   1. Location: As indicated on Drawings.

D. Corrugated Metal Roofing Panels: 24 Gauge, 32" x 7/8", interlocking, Galvalume steel panel with exposed fastening system and high grade hot melt elastomeric sealant to seal adjoining panel legs. Panel shall be Berridge "S-Deck Panel", with Signature 300 (Kynar 500) "Cool Roof" 70% PVDF fluoropolymer resin coating in color as selected by Architect from Manufacturer's standard range, or approved equal.
   1. Location: As indicated on Drawings.

E. Battens/Snap Covers: Commercial quality, .125" extruded snap cover and receiver of 6063-T5 aluminum alloy with clear anodized finish in profiles and sizes as detailed on drawings to match existing battens in proximity of work (field verify).

F. Aluminum Trim: Miscellaneous extruded and formed aluminum components shall match profiles of existing trim and/or as detailed on drawings.

G. Closures: Pre-molded neoprene and/or sheet metal shaped to fit the panel contour.

H. Anchoring Devices: Provide spacers, fasteners, clips, angles and other devices necessary to install metal panels.

I. Accessory Materials:
   1. Panel Fasteners: Galvanized steel with washers where required.
   2. Aluminum Trim Fasteners: Exposed fasteners shall be aluminum or stainless steel. Unexposed fasteners may be cadmium or zinc plated steel in accordance with ASTM A164-55 and 165-55. Steel anchors shall be properly insulated from aluminum.
   3. Sealant: Color-coordinated, primerless silicone or high grade, non-drying butyl as recommended by panel manufacturer. Do not use sealant containing asphalt.

J. Filler: Non-solvent epoxy polyamide sealer shall be Tnemec's 62-1400, "Seam Sealer".

K. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils 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 per ASTM D 1970.
3. Available Products: Subject to compliance with requirements and approval of roofing panel Manufacturer, provide one of the following, or other approved comparable product. Product provided must be acceptable to roofing panel Manufacturer for use with their products and specified warranty. Coordinate details for interface of underlayment provided with other air barrier and dampproofing systems as indicated in other Division 07 Sections. Acceptable products may include the following:
   a. Carlisle WIP Products, a division of Carlisle Construction Materials; 40 mil, WIP 300HT.
   c. Polyglass a MAPEI Company, 60 mil. Polystick MTS

L. Roof Curbs: Curbs in metal panel shall be fabricated from same material as roof panels, 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 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. Insulate roof curb with 1-inch thick, rigid insulation. Coordinate requirements with Division 07 Section "Roof Accessories", and other trades as required.

PART 3 - EXECUTION

3.01 COORDINATION AND INSPECTION

A. Coordinate with other trades, prior to rough-in and penetrations, exact locations for roughing-in of components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels. Pipe and other small penetrations shall not be located in roof panel seams. Large equipment shall be located to avoid valleys and damming conditions to the maximum extent possible. Examine and confirm these locations again before installation to avoid conflicts.

1. Provide metal roof panel crickets at roof curbs that do not fit entirely between the seams of a single roof panel with at least 2” to the seam on both sides. Coordinate size of crickets with actual equipment and curbs to be provided. Coordinate height of crubs as required for crickets prior to ordering curbs.

2. Contractor is responsible to relocate pipe and similar penetrations as required to avoid seams, and to relocate curbs and larger equipment as required to avoid dams or other ponding conditions. Contractor shall not be due additional compensation to relocate items and make other corrections as required due to failure of Contractor to coordinate between trades.

B. Fabricator and erector are responsible for inspecting existing conditions to verify general conditions, panel profiles and panel attachments and examine all parts of existing building affecting the installation of his work.

1. 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.

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

3.02 SELF-ADHERING UNDERLAYMENT INSTALLATION
A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply underlayment, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches and staggered 24 inches between courses. Overlap side edges not less than 4 inches. Roll laps with roller. Extend underlayment into gutter troughs. Cover underlayment within 14 days or Manufacturer's maximum exposure time, whichever is less.
1. Apply over the entire roof surface.

3.03 PANEL INSTALLATION
A. Panels indicated on drawings as damaged and therefore to be replaced shall be field cut in workmanlike manner to appropriate lengths for installation.
B. Install metal panels, fasteners, trim and related sealants in accordance with approved shop drawings and as may be required for a weathertight installation.
C. Remove all strippable coatings and provide a dry wipe-down cleaning of the panels as they are erected.
1. Comply with Manufacturer's installation instructions for cleaning. Do not use cleaners or methods that will affect the weathering of panels intended to weather or patina, unless otherwise indicated for pre-patina treatment.
D. Install panels to interlock with adjoining panels in order to prevent water penetration and air leakage per industry standards.
E. Fasten panels to substrate with concealed fasteners per manufacturer's recommendations.
F. Panels shall be installed plumb and true in proper alignment with existing lines of panels.
G. Lap Sealing: Seal side and end laps of metal panels per Manufacturer's recommendations and installation instructions.

3.04 ACCESSORY INSTALLATION
A. Dissimilar Materials: Isolate aluminum surfaces from contrasting steel or other ferrous metals using EC-1202 tape or zinc chromate paint.
B. Closures: Furnish and install closures where missing at all ends of existing horizontal siding abutting window framing, door frames, storefront, adjoining walls, etc. where panel profile is exposed to view. Closure shall be installed using proper adhesive and fit flush with edge of panel. Caulk perimeter of closure. Coordinate installation with paint preparation and painting.
C. Battens: Attach receiver to substrate using zinc or cadmium plated steel fasteners insulated from aluminum. Snap batten in place to align with existing battens as shown on drawings.
D. Trim: Install aluminum trim using specified fasteners at location shown on drawings.

3.05 PROTECTION AND REPAIR
A. If applicable, remove factory protective plastic coatings at time as recommended by roofing Manufacturer. Do not allow protective coatings to melt onto roof panel surfaces.
1. For metal surfaces intended to weather or patina, wear gloves and take precautions to avoid spills, oil from hands and skin, etc. that can leave marks or cause uneven weathering of panel surfaces. Require the same of other trades working on or near panel surfaces after installation.
B. Protect panels from damage during remainder of construction period. Upon determination of responsibility, repair or replace damaged metal panels and trim to the satisfaction of the Architect and / or Owner.
3.06 REPAIR OF METAL PANELS & SIDING

A. Damaged or rusting panels/siding shall be patched with sheet metal and caulked as required, or as detailed on the drawings. Dented panels / siding or panels / siding with small penetrations (less than 5/8" diameter) shall receive filler. Prepare substrate and apply filler according to manufacturer's instructions to adhere to surface and achieve a smooth, blended surface for receiving paint.

END OF SECTION 07 40 00
SECTION 07 46 46 - MINERAL-FIBER CEMENT SIDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. This Section includes Pre-Stained & Paint-Grade for the following:
   1. Fiber-cement siding, panels and accessories.
   2. Fiber-cement trim.

B. Related Sections include the following:
   1. Division 06 Section - Rough Carpentry.
   2. Division 06 Section - Finish Carpentry for wood, wood-based sidings and exterior trim.
   3. Division 07 Section - Sheathing.
   4. Division 07 Section - Sheet Metal Flashing and Trim for flashing, gutters, and other sheet metal work.
   5. Division 07 Section - Joint Sealers.
   6. Division 07 Section - Weather Resistant Barrier for building wrap application.
   7. Division 09 Section - Painting.

1.03 SUBMITTALS

A. Product Data:  For each type of product indicated, including material descriptions, available colors, dimensions and available finishes & patterns

B. Samples for Verification:  For each type, color, texture, and pattern required.
   1. 12-inch- long-by-actual-width Sample of siding.

C. Maintenance Data:  For each type of product indicated.

1.04 QUALITY ASSURANCE

A. Source Limitations:  Obtain each type, color, texture, and pattern of siding and soffit, including related accessories, through one source from a single manufacturer.

B. Mockup:  Build mockup to verify selections made under sample submittals and to demonstrate aesthetic effects.
   1. Build mockup of typical wall area as shown on Drawings.
   2. Build mockup approximately 48 inches long by 60 inches high.  Include outside corner on one end of mockup and inside corner on other end.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store materials in a dry, well-ventilated, weathertight place.

1.06 PROJECT CONDITIONS
A. Weather Limitations: Proceed with siding installation only if substrate is completely dry and if existing and forecasted weather conditions permit siding to be installed according to manufacturer's written instructions.

1.07 SEQUENCING
A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

1.08 WARRANTY
A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace siding that does not comply with requirements or that fails within specified Warranty period. Failures include, but are not limited to, cracking, deforming, fading or otherwise deteriorating beyond normal weathering.
   1. Warranty Period: 25 years, from date of Substantial Completion.

1.09 EXTRA MATERIALS
A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Furnish full lengths of soffit and trim in a quantity equal to 2 percent of amount installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Subject to compliance with project requirements, manufacturer’s offering Products which may be incorporated in the Work include the following:
   1. Basis of Design: James Hardie Building Products, (800) 9-HARDIE.
   2. Approved alternate Manufacturer: CerainTeed Corporation, (800) 233-8990

2.02 SIDING
A. Pre-Stained Fiber-Cement Lap Siding:
   1. Non-asbestos fiber-cement siding, to comply with ASTM C 1186, Type A, Grade II.
   2. Type: "James Hardie Building Products" Stain Finish Cedar Lap Siding, 8 ¼" (7" Exposure). Pre-stained finish color as selected by Architect.

2.03 SOFFIT
A. Pre-Stained Fiber-Cement Soffit: Panels made from fiber-cement board that does not contain asbestos fibers; complies with ASTM C 1186, Type A, Grade II; is classified as noncombustible when tested according to ASTM E 136; and has a flame-spread index of 25 or less when tested according to ASTM E 84.
   2. Pattern: 12-inch- wide sheets with smooth texture or width as required at porches typical.

2.04 ACCESSORIES
A. Fiber-Cement Accessories: Provide trim and other items as recommended by manufacturer for building configuration. Sizes as required, or as indicated on the drawings.
   1. Texture: Wood grain.
   2. Finish: Pre-Stained finish color as selected by Architect.

B. Decorative Accessories: Provide the following types of decorative accessories as indicated:
   1. Corner boards.
2. Door and window casings.
3. Fascia.
4. Moldings and trim.

C. Colors for Decorative Accessories: Match adjacent siding.

D. Flashing: Provide aluminum flashing complying with Division 07 Section - Sheet Metal Flashing and Trim at window and door heads and where indicated.

E. Elastomeric Joint Sealant: Single-component urethane joint sealant complying with requirements in Division 07 Section - Joint Sealants for Use NT (nontraffic) and for Uses M, G, A, and, as applicable to joint substrates indicated, O joint substrates.

F. Fasteners:
   1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of 1 inch into substrate.
   2. For fastening aluminum, use aluminum fasteners. Where fasteners will be exposed to view, use prefinished aluminum fasteners in color to match item being fastened.
   3. For fastening fiber-cement siding, use hot-dip galvanized fasteners.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION
A. Clean substrates of projections and substances detrimental to application.

3.03 INSTALLATION
A. General: Comply with siding manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply. Center nails in elongated nailing slots without binding siding to allow for thermal movement. Overlap joints to shed water away from direction of prevailing wind.

B. Fiber Cement Siding:
   1. Blind nail to sheathing.
   2. Locate splices at least 12 inches away from window and door openings. Splices shall not align on adjacent members.
   3. Wind Resistance: Where a specified level of wind resistance is required, lap siding shall be installed to framing members and secured with fasteners, as described in Table No. 2 of National Evaluation Service Report No. NER-405.
   4. Surface nailing at splices may be required by Architect.

3.04 FINISHING
A. Pre-stained Finish as shown on the documents.
B. Painted Finish as shown on the documents.

3.05 ADJUSTING AND CLEANING
A. Remove damaged, improperly installed, or otherwise defective siding materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to siding manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 07 46 46
SECTION 07 46 46 - MINERAL-FIBER CEMENT SIDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 01 Specification Sections, apply to this Section.
   B. General Contractor shall coordinate construction operations included in different Sections of
      the Specifications to ensure efficient and orderly installation of each part of the Work that
      depend on each other for proper installation, connection, and operation.

1.02 SUMMARY
   A. This Section includes Pre-Stained & Paint-Grade for the following:
      1. Fiber-cement siding, panels and accessories.
      2. Fiber-cement trim.
   B. Related Sections include the following:
      1. Division 06 Section - Rough Carpentry.
      2. Division 07 Section - Sheathing.
      3. Division 07 Section - Sheet Metal Flashing and Trim for flashing, gutters, and other sheet
         metal work.
      4. Division 07 Section - Joint Sealers.
      5. Division 07 Section – Fluid Applied Weather Barrier Resistant Barrier.
      6. Division 09 Section - Painting.

1.03 SUBMITTALS
   A. Product Data: For each type of product indicated, including material descriptions, available
      colors, dimensions and available finishes & patterns
   B. Samples for Verification: For each type, color, texture, and pattern required.
      1. 12-inch- long-by-actual-width Sample of siding.
   C. Maintenance Data: For each type of product indicated.

1.04 QUALITY ASSURANCE
   A. Source Limitations: Obtain each type, color, texture, and pattern of siding and soffit,
      including related accessories, through one source from a single manufacturer.
   B. Mockup: Build mockup to verify selections made under sample submittals and to
      demonstrate aesthetic effects.
      1. Build mockup approximately 48 inches long by 60 inches high. Include outside corner
         on one end of mockup and inside corner on other end.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Store materials in a dry, well-ventilated, weathertight place.

1.06 PROJECT CONDITIONS
   A. Weather Limitations: Proceed with siding installation only if substrate is completely dry and
      if existing and forecasted weather conditions permit siding to be installed according to
      manufacturer's written instructions.
1.07 SEQUENCING
A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

1.08 WARRANTY
A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace siding that does not comply with requirements or that fails within specified Warranty period. Failures include, but are not limited to, cracking, deforming, fading or otherwise deteriorating beyond normal weathering.
1. Warranty Period: 25 years, from date of Substantial Completion.

1.09 EXTRA MATERIALS
A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Furnish full lengths of soffit and trim in a quantity equal to 2 percent of amount installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Subject to compliance with project requirements, manufacturer’s offering Products which may be incorporated in the Work include the following:
1. Basis of Design: James Hardie Building Products, (800) 9-HARDIE.
2. Approved alternate Manufacturer: CerainTeed Corporation, (800) 233-8990

2.02 SIDING
A. Pre-Stained Fiber-Cement Lap Siding:
1. Non-asbestos fiber-cement siding, to comply with ASTM C 1186, Type A, Grade II.
2. Type: "James Hardie Building Products" Stain Finish Cedar Lap Siding, 8 ¼" (7" Exposure). Pre-stained finish color as selected by Architect.

2.03 SOFFIT
A. Pre-Stained Fiber-Cement Soffit: Panels made from fiber-cement board that does not contain asbestos fibers; complies with ASTM C 1186, Type A, Grade II; is classified as noncombustible when tested according to ASTM E 136; and has a flame-spread index of 25 or less when tested according to ASTM E 84.
1. Basis-of-Design Product: HardieSoffit panels or a comparable product as approved by Architect:
2. Pattern: 12-inch- wide sheets with smooth texture or width as required at porches typical.

2.04 ACCESSORIES
A. Fiber-Cement Accessories: Provide trim and other items as recommended by manufacturer for building configuration. Sizes as required, or as indicated on the drawings.
1. Texture: Wood grain.
2. Finish: Pre-Stained finish color as selected by Architect.

B. Decorative Accessories: Provide the following types of decorative accessories as indicated:
1. Corner boards.
2. Door and window casings.
3. Fascia.
4. Moldings and trim.
C. Colors for Decorative Accessories: Match adjacent siding.

D. Flashing: Provide aluminum flashing complying with Division 07 Section - Sheet Metal Flashing and Trim at window and door heads and where indicated.

E. Elastomeric Joint Sealant: Single-component urethane joint sealant complying with requirements in Division 07 Section - Joint Sealants for Use NT (nontraffic) and for Uses M, G, A, and, as applicable to joint substrates indicated, O joint substrates.

F. Fasteners:
   1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of 1 inch into substrate.
   2. For fastening aluminum, use aluminum fasteners. Where fasteners will be exposed to view, use prefinished aluminum fasteners in color to match item being fastened.
   3. For fastening fiber-cement siding, use hot-dip galvanized fasteners.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.03 INSTALLATION

A. General: Comply with siding manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply. Center nails in elongated nailing slots without binding siding to allow for thermal movement. Overlap joints to shed water away from direction of prevailing wind.

B. Fiber Cement Siding:
   1. Blind nail to sheathing.
   2. Locate splices at least 12 inches away from window and door openings. Splices shall not align on adjacent members.
   3. Wind Resistance: Where a specified level of wind resistance is required, lap siding shall be installed to framing members and secured with fasteners, as described in Table No. 2 of National Evaluation Service Report No. NER-405.
   4. Surface nailing at splices may be required by Architect.

3.04 FINISHING

A. Pre-stained Finish as shown on the documents.

B. Painted Finish as shown on the documents.

3.05 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective siding materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to siding manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 07 46 46
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Provide all metal flashing and sheet metal work, as shown on the drawings and as herein specified.

B. Related Sections include the following:
   1. Division 04 Section - Unit Masonry for through-wall flashing.
   2. Division 06 Section - Rough Carpentry for blocking, nailers, etc.
   3. Division 06 Section – Exterior Wood Siding.
   4. Division 07 Section - Joint Sealers.
   5. Division 07 Section - Painting.
   6. Division 07 Section - Metal Roof Panels for sheet metal flashing and trim integral with metal roof panels.
   7. Division 07 Section - Roof Accessories for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.03 PERFORMANCE REQUIREMENTS AND QUALITY ASSURANCE

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 the latest edition of 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. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, over stressing 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. Account for temperature change of 120 deg F ambient, 180 deg F material surfaces.

D. Installer: Engage an experienced installer who has completed similar work of a comparable scale with a record of successful performance.

1.04 WARRANTY & GUARANTEE
A. Sheet metal applicator and General Contractor shall personally guarantee sheet metal work for a period of Two-Years after acceptance of the building by the Owner against any defects or water leaks. Guarantee shall include all labor and materials necessary to correct any defects or water leaks upon notice from the Owner.

B. Furnish manufacturer's standard 20 year warranty stating architectural fluorocarbon finish will be:
   1. Free of fading of color change in excess of 6 NBS units as measured per ASTM D 2244-68;
   2. Will not chalk in excess of numerical rating of 7 when measured in accordance with standard procedures specified in ASTM D 659-74;
   3. Will not peel, crack, chip, or de-laminate.

1.05 SUBMITTALS
A. Division 01 Section - Submittal Procedures: Procedures for submittals.
B. Submit shop drawings for review and approval prior to ordering of materials and fabrication of the required shapes and metal flashings. Provide full details of coping system including typical parapet conditions, stone caps, splice joints, inside and outside corners, intersections, other special conditions, and areas indicated per drawings.
C. Failure by the contractor to submit shop drawings required above shall release the Architect from any liabilities due to the negligence on the part of the Contractor to comply with the construction documents.
D. Samples: Submit samples of sheet metal flashings, trim, copings, accessory items, and prefinished items of profiles, gauge and finish to be used.
E. Informational Submittals:
   1. Qualifications: For sheet metal installer, and fabricator of copings.
   2. Certifications: Certifying products meet code and specified requirements.

PART 2 - PRODUCTS
2.01 MATERIALS
A. Sheet metal for receivers and counter-flashings: 24 gauge or as noted on drawings galvanized sheet steel bent to required shapes.
B. Sheet metal for eave flashing, copings, drip edges and similar exposed items shall be 20 gauge hot-dip galvanized sheet steel. Bend to required shapes.
C. Lead: Weight 4 lbs. per square foot.
D. Solder: ASTM D32, Alloy gauge 58, 50% tin, 50% lead.
E. Gutters and Downspouts: Design and provide single bead half-round gutter with 6” flange for standing seam metal roof, 20 Gauge prefinished galvanized steel with Kynar 500 coating. Design and provide 1” straps and bracket hangers at 30” o.c. max.
   1. Color: Kynar coating color as selected by Architect from manufacturer’s full range.
   2. Custom ½ round gutters and round downspouts, as indicated on Drawings. Design gutters and downspouts to safely accommodate weight of water at design rainfall per local code requirements.
   3. Precast Concrete Splash blocks: 12” x 24”; provide one per downspout that discharges at grade, except where downspouts otherwise discharge to below grade piping.
   4. Transitions to below-grade piping: Where downspouts discharge to below grade piping but downspout boots are not indicated, provide flexible UV-resistant PVC boot transitions as required.
F. Shop-Fabricated Coping System: Minimum of 20 Gauge galvanized steel pre-formed, prefinished cap installed over drainable 20 gauge galvanized steel perforated cleat, 12" wide at 60" centers. Increase minimum gauges of cap and cleats, and decrease cleat spacing as required to meet specified standards and performance criteria. Cleat secured with nails into P.T. wood blocking. Internal supports and concealed splice plates. Basis of Design construction shall be patterned on the OMG Roofing Products "Permasnap-2" Coping System. Cap shall receive Kynar coating in color to be selected by the Architect. Provide continuous welded pre-formed corners and intersections.

1. Coping: Fabricated from minimum 20 gauge galvanized, prefinished steel unless otherwise noted.
2. Coping Corners and Intersections: Mitered, preformed and continuously welded.
3. Cleats: Fabricated from same material as coping.
4. Splice Plates: Concealed, of the same material and finish as coping.
5. Finish for Galvanized Steel: Kynar coating in colors as selected by Architect.

G. Shop-Fabricated Fascia: 20 Gauge galvanized steel pre-formed fascia installed over roofing membrane. Basis of Design construction shall be as profiled on the drawings, or shall be patterned after OMG Roofing Products "Extruded TerminEdge BUR & Mod Bit", or approved equal.

1. Fascia Cover: Fabricated from 20 Gauge galvanized steel, prefinished unless otherwise noted.
2. Corners: Mitered, preformed and continuously welded.
3. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
4. Finish for Galvanized Steel: Kynar coating in colors as selected by Architect.

H. Finish for Galvanized Steel: Kynar coating in colors as selected by Architect.

I. Nails for Sheet Metal Work: 10 Gauge galvanized ring type steel of sufficient length to adequately secure sheet metal work.

J. Precast Concrete Splashblock: 12" x 24"; provide one per downspout.

K. Aluminum Trim Fasteners: Exposed fasteners shall be aluminum or stainless steel. Unexposed fasteners may be cadmium or zinc plated steel in accordance with ASTM A164-55 and 165-55. Steel anchors shall be properly insulated from aluminum.

L. Roof Penetration Flashing: Lead coated copper 16 oz./SF. Roof Penetration Flashing: Lead coated copper 16 oz./SF.

M. Through-Wall, Door/Window Sill and Head Flashings:
   1. Where embedded in masonry (not exposed to view): 3 oz. copper composite Multi-Flash 500 by York or approved equal. See Division 4 section “Unit Masonry”.
   2. Where exposed to view: Prefinished 24 gauge galvanized steel with PVDF coating in color(s) as selected by Architect. Provide with drip edges hemmed 1/2" on underside.

N. Prefinished Metal Jamb Flashing: Provide prefinished 20-gauge galvanized steel with PVDF coating in color(s) as selected by Architect. Provide with drip edges hemmed 1/2".

O. Reglets: Equal to Fry original metal reglet.

P. Counter Flashing. "Springlock Flashing" by Fry Reglet.

Q. Sheet Metal Fasteners: Galvanized steel with washers where required.

2.02 FABRICATION

A. All exposed edges shall be hemmed 1/2" on underside.

2.03 ALUMINUM FINISHES
A. General: Comply with Aluminum Association’s (AA) "Designation System for Aluminum Finishes: for finish designations and application recommendations.

B. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating; as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer’s instructions.
   1. Fluoropolymer 2-Coat Coating system: Manufacturer’s standard 2-coat, thermo cured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 605.2.
      a. Color and Gloss: As selected by Architect from manufacturer’s full range of choices for color and gloss.

PART 3 - EXECUTION

3.01 INSPECTION OF SURFACES
   A. Applicator responsible for inspecting substrates upon which sheet metal materials are to be placed for any defects or conditions that would impair finished installation. Application constitutes acceptance of the substrate.

3.02 APPLICATION
   A. Details shown are design details, fabrication techniques, and methods as per SMACNA recommendations.
   B. Proper and adequate provisions shall be made in fabrication, installing and fastening sheet metal work for expansion and contraction of metal and other materials entering into the work so that pulling, splitting, opening of joints, warpage or other failure of the work shall be prevented. Expansion joints in sheet metal placed not farther than 40 feet apart. Dissimilar metal surfaces contacting one another, protected by bituminous coating to prevent galvanic or corrosive action from occurring.
   C. Counter flashing constructed in lengths not exceeding 10 feet and installed in receiver so that flashing lays tightly against base flashing and overlaps base flashings a minimum of 4 inches. Joints between sections shall be tight and lay flat. Metal at corners continuous. Bent, crimped or warped sections are not permitted.
      1. Coordinate counterflashings with roofing installation of termination bars at top edge of roofing base flashings.
   D. Coping constructed in lengths not exceeding 10 feet. Joints between sections shall be tight and lay flat over splice plates. Coping shall be fastened with continuous clips both sides over 45 mil neoprene sheet. Bent, crimped or warped sections are not permitted. Metal at corners shall be soldered.

3.03 INSTALLATION
   A. General: unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer’s installation instructions, and SMACNA’s "Architectural Sheet Metal Manual." Anchor units of Work securely in place by method indicated, providing for thermal expansion of metal units; conceal fasteners 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 weatherproof.
      1. All complete work shall be water and weathertight. Joints, cuts, miters, splices or other installation means made as neat as possible. Fastenings as inconspicuous as possible.
B. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicate, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Expansion Provisions: Provide for thermal expansion of exposed sheet metal work. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches, except where pretinned surface would show in finished Work.
   1. Do not solder the following metals:
      a. Aluminum.
   2. Pretinning is not required for the following metals:
      a. Lead-coated copper.
   3. 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.

E. Copings: Install with concealed splice plates, preformed corners, and positive drainage (inward slope) on top surface. No exposed fasteners through copings allowed.

F. Sealed Joints: Form no expansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
   1. Use joint adhesive for nonmoving joints specified not to be soldered.

G. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

H. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
   1. Underlayment: Where installing stainless steel or aluminum directly on cementitious or wood substrates, install a slip sheet of red-rosin paper and a course of polyethylene underlayment.

I. Roof-drainage System: Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA’S Manual or the item manufacturer, to drain roof in the most efficient manner. Coordinate roof-drain flashing installation with roof-drainage system installation. Coordinate flashing and sheet metal items for steep-sloped roofs with roofing installation.

J. Roof-Penetration Flashing: Coordinate roof-penetration flashing installation with roofing and installation of items penetrating roof. Install flashing as follows:
   1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
   2. Seal and clamp flashing to pipes penetrating roof, other than lead flashing on vent piping.

K. Precast Concrete Splash Blocks: Install where downspouts discharge on grade unless otherwise shown.

3.04 FLASHING & COUNTERFLASHING REQUIREMENTS
A. Joints in thru-wall flashings and counterflashings shall be lapped 4" minimum with laps bedded in sealant.

B. Head and sill flashings shall not have joints and shall have sides turned up (edge dams) with all corners folded, not cut and shall extend 9" minimum beyond both sides of opening.

C. Head, sill and thru-wall flashings shall be set in a bead of sealant applied under the exterior edge of the flashing and on top of the masonry or lintel angle on which the flashing rests.

D. Penetrations in thru-wall flashing are not permitted. Vents in thru-wall flashing shall be completely flashed and water tight.

E. Metal reglets shall have a bead of sealant installed to complete system with counterflushing.

F. All thru-wall flashing shall extend through and up the interior face of exterior gypsum sheathing, as applicable.

G. Install metal jamb flashing, in material as noted, over adjacent air barrier system at jambs of curtainwall and other locations as shown on the drawings, as required to close openings to cavity wall. Mechanically attach with stainless steel fasteners and seal metal flashing to wall / air barrier with self adhering membrane flashing as specified in Division 07 Section - Modified Bituminous Sheet Air Barriers.

3.05 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

END OF SECTION 07 62 00
SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary
   Conditions and Division 01 Specification Sections, apply to this Section.
B. General Contractor shall coordinate construction operations included in different Sections of
   the Specifications to ensure efficient and orderly installation of each part of the Work that
   depend on each other for proper installation, connection, and operation.

1.02 SUMMARY
A. Section Includes:
   1. Provide roof accessories including pipe pedestals, pipe portals and other items as indicated
      on the drawings.
B. Related Sections include the following:
   1. Division 06 Section - Rough Carpentry, for wood blocking.
   2. Division 07 Section - Roofing Section(s).
   3. Division 07 Section - Sheet Metal Flashing and Trim.
   4. Division 07 Section - Sealants.
   5. Division 22 Sections for Plumbing.
   6. Division 23 Sections for Mechanical.
   7. Division 26 Sections for Electrical.

1.03 QUALITY ASSURANCE
A. Comply with "NRCA Roofing and Waterproofing Manual" for installation of units.

1.04 SUBMITTAL
A. Submit manufacturer technical product data and rough-in diagrams, details.

1.05 PRODUCT DELIVERY
A. Deliver products in manufacturers original unopened packages, clearly marked with brand
   name and model number.
B. Store materials on clean, raised platforms with weather protective covering when stored
   outdoors.

1.06 WARRANTY
A. Manufacturer shall guarantee against defects in material and workmanship for a period of five
   years.
B. Metal roof pipe boot warranty: Manufacturer's standard 20 year warranty.

1.07 PROJECT CONDITIONS
A. Any equipment curb heights indicated in Drawings are minimum curb heights required in
   general. Taller curbs may be required for minimum height above adjacent roofing for roof
   warranty, including tapered insulation and crickets. All curbs shall be tall enough to
   accommodate minimum curb height, or minimum heights above roof as indicated in Drawings,
   or minimum 8" above highest adjacent roof surface, whichever is greatest. Coordinate with
   roofing installer to confirm total curb heights required.
B. Do not install materials during inclement weather or when air temperature may fall below 40°F, including wind chill.
C. Do not install materials over damp, frozen or otherwise unsuitable surface.

PART 2 - PRODUCT

2.01 MANUFACTURERS
A. Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
   1. BILCO Company, New Haven, CT, (203) 934-6363
   2. Custom Curb, Incorporated, Chattanooga, TN (800) 262-6669.
   4. The Pate Company, Broadview, IL (800) 243-3018.
   5. Thybar Corporation, Addison, IL (708) 543-5300.
B. Division 01 Section - Product Requirements: Product options and substitutions. Substitutions: Permitted.

2.02 MATERIALS
A. Pipe Seal Boots for Metal Roof: Gasketed pipe boot with flexible aluminum base plate and integral graduated silicone pipe seal. Silicone seals shall be UV and ozone resistant and rated for high temperature resistance (tested to minimum 225°F continuous exposure). Subject to compliance with requirements, provide Aztek Washer Company "Master Flash", Marco Industries "Roof Boots", or approved equal.
   1. Type and configuration to suit roof pitch.
   2. Sizes: Sized to pipe penetrations.
   3. Color: Light Gray
   4. Hardware: Provide with adjustable metal clamp for clamping top of graduated boot to pipe, and Manufacturer's recommended base fasteners for the conditions and substrates as indicated.
B. Accessories:
   1. Fasteners: Manufacturer's recommended gasketed fasteners for substrates and conditions indicated.
   2. Sealants: As recommended by Manufacturer for conditions and substrates indicated. Where sealants may be visible in completed work, sealant colors shall match roofing or adjacent materials as selected by Architect from available standard colors.

PART 3 - EXECUTION

3.01 COORDINATION
A. Coordinate between trades as required to ensure waterproof installation acceptable to roofing installer and Manufacturer.
   1. Ensure roof curbs meet minimum height requirements above adjacent roofing, including insulation thickness, tapered insulation, and crickets.
   2. Verify and coordinate actual roof slopes as required for level top of curbs.
   3. Coordinate installation of roofing membrane pads under all support pedestals.
B. Coordinate between roofing, mechanical, plumbing and other trades as required to ensure that duct and pipe penetrations occur in the middle of roof panels and not at [standing] seams between panels. Locate ducts and offset pipes below roof deck penetrations as required to avoid roofing seams.
3.02 **INSPECTION**

A. Examine areas to receive roof accessories to insure work of preceding trades is completed. Check surfaces to see that they are uniform in place, free from grease, oil or other debris which would affect proper installation. Application constitutes acceptance of substrate conditions.

3.03 **INSTALLATION**

A. Accessories installed in accordance with current printed recommendations of Manufacturer and to roofing manufacturer's requirements.

B. Coordinate installation of accessories with roof and flashing installations. Provide weathertight installation.

C. Accessories secured in place to withstand wind loads in accordance with the local building codes.

D. Fasteners, General: All fasteners shall be installed straight and to make proper seal at gaskets. No fasteners of any sort are allowed through top side of curb cap flashings. All fasteners in flashing caps shall be through vertical sides only. No fasteners of any sort are allowed through roofing membranes or materials unless specifically approved in writing by roofing installer and manufacturer, and approved by Architect.

END OF SECTION 07 72 00
SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Furnish all labor, materials, tools, equipment and related items required for the complete installation of firestopping at penetrations through rated partitions and floors.

B. Related Sections include the following:
   1. Division 07 Section - Fire-resistive Joints.
   2. Division 09 Section - Drywall Partitions.

1.03 STANDARDS

A. All work under this section shall conform to the requirements of the Underwriters' Laboratories, Inc., the National Board of Fire Underwriters and the local building code. Where requirements specified differ from the requirements of any authorities having jurisdiction, the more stringent requirements shall apply.

B. Firestopping system shall be a complete system of materials supplied by one manufacturer.

1.04 QUALITY ASSURANCE

A. Source Limitations: Construction Manager shall engage a single entity to assume full responsibility for installation of all fire penetration firestopping, fire resistive joints, and fire penetration assemblies throughout project, both for items specified herein, and items as specified in other referenced specification Sections.

B. Qualifications of Installer:
   1. Five years experience in performing installation of materials with similar quantities of fireproofing materials.
   2. A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

C. Requirements of regulatory agencies:
   1. Building code requirements of the municipality for fire resistance ratings of areas to receive fireproofing materials.
   2. Underwriters' Laboratories, Inc.: Classification marking.
D. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
   1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Penetration firestopping is identical to those tested per testing standard referenced.

E. Testing:
   1. Fire resistant rating of assemblies - ASTM E-814.
   2. Compound shall meet all requirements of UL 1479.

1.05 SUBMITTALS
A. Installer's qualifications.
B. Test Reports
   1. Submit copies of fire test reports of fireproofing installation to substrate materials required.
   2. Submit certified test reports of acceptable testing agencies which perform testing in accordance with ASTM E-119 and E-84.
C. Manufacturer's Instruction: Furnish manufacturer's printed material specifications and installation instruction for each type of fireproofing.
D. Certificates:
   1. Furnish manufacturer's certification that materials meet or exceed specification requirements.
   2. Furnish applicators certification that material has been completed as specified to meet fire resistance ratings and application requirements.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING
A. Deliver materials in original, unopened packages bearing name of manufacturer and product identification.
B. Reject damaged packages found unsuitable for use and remove from job site.
C. Store materials off ground, under cover, and away from damp surfaces.
D. Keep materials dry at all times.

PART 2 - PRODUCTS
2.01 MATERIALS, GENERAL
A. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Horizontal assemblies include floors, floor/ceiling assemblies, & ceiling membranes of roof/ceiling assemblies.
   2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
   3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
B. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
   1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.
C. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

2.02 MATERIALS

A. Safing Insulation: Forming material, minimum 3" unfaced safing insulation with a nominal density of 4 pcf, and bearing the UL Classification Marking shall be "Thermafiber" as manufactured by Owens Corning.

B. Compound: Pliable, non-toxic, non-combustible, non-asbestos, low density, lightweight compound shall be "Firecode" as manufactured by USG Corp., "Flame Stop V" as manufactured by Flame Stop Inc. or "Metacaulk" as manufactured by Rectorseal.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that all substrates to receive firestopping system are constructed according to the Construction Documents and acceptable to receive fire stop materials.

3.02 APPLICATION

A. Safing Insulation: Cut safing insulation slightly wider than the opening. Compress and tightly fit min. 2 1/2" or 3" thickness of insulation with nominal density of 4 pcf completely around penetrant.

B. Firestopping Compound: Trowel apply the compound from its container and work into the penetration opening. Apply compound to minimum 1/2" to 1" thickness on top of safing insulation. Ensure that compound is in contact with all surfaces and that entire opening is filled with safing and compound. Utilize appropriately rated product for specific rated partition application.

END OF SECTION 07 84 13
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY
A. Section Includes: Provide sealant required to close joints that would allow moisture or air to enter structure between fixed materials, as shown on the drawings and as herein specified, including but not limited to:
1. Sealing of interior perimeter joints of window framing, door frames, and other openings in walls.
2. Sealing interior and exterior walls to floor or roof decking/construction for fire resistive or thermal, moisture or acoustical barrier.
3. Setting of thresholds in sealant.
4. Sealing of joints between countertops and wall surfaces for a sanitary joint.
5. Sealing of joints of every nature and description that would allow moisture or air penetration.
6. Sealing of joints indicated to be caulked or sealed specifically mentioned herein or not.
7. Sealing around all pipe, duct and vent penetrations.
8. Sealing at paving joints.
B. Related Sections include the following:
1. Division 04 Section - Unit Masonry Assemblies.
2. Division 06 Section - Sheathing
3. Division 06 Section - Interior Architectural Woodworking
4. Division 07 Sections – Thermal Insulation
5. Division 07 Sections – Fluid Applied Weather Barriers
6. Division 07 Section - Sheet Metal Flashing and Trim.
7. Division 07 Section - Metal Roof Panels.
8. Division 08 Section - Aluminum Folding Doors, Entrances and Storefront.
9. Division 09 Section - Ceramic Tiling.
10. Division 09 Section - Gypsum Board.
11. Division 09 Section - Painting.
12. Division 22 Section - Plumbing.
13. Division 23 Section - Mechanical.
14. Division 26 Section - Electrical.
15. Division 32 Section - Paving.

1.03 JOB CONDITIONS
A. Environmental Conditions: Sealant work not permitted when air temperature is below 40 degrees F.

1.04 SUBMITTALS
A. Product Data: Submit manufacturer's product specifications, color range, handling/installation/curing instructions, and performance tested data sheets for each elastomeric product or joint backing material.

B. Samples: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Submit samples of joint backing material.

1.05 WARRANTY

A. The Contractor shall submit, in writing, a warrant that all sealant work executed under this Section shall be free from defects in materials and workmanship for a period of two (2) years from date of acceptance of the Project, and he shall remedy any defects in the sealant work during the warranty period.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.02 MATERIALS

A. Chemical Compatibility, General: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Primers: Non-staining type as recommended by sealant manufacturer for each working surface. Material shall not leave residue or stain on adjacent surfaces. Each joint must be primed prior to sealing.

C. Sealant for Interior and Exterior Masonry Control Joints: 1 part ultra low modulus silicone sealant equivalent to "Spectrum 1" by Tremco, or "890 NST" by Pecora. Color as selected by Architect from manufacturers standard range.

D. Materials for sealing top of wall to bottom of decking:
   1. For use at non-fire-rated (thermal and/or acoustical) construction: The following products are acceptable for thermal and air seal between top of wall and bottom of deck. At contractor’s option, use one of the following products:
      a. Closed cell 2-component spray applied polyurethane foam insulation and air barrier, Icynene ProSeal, or comparable product by another Manufacturer.
      b. Single component, gun applied, closed cell polyurethane insulating foam sealant for gaps up to 3": Great Stuff Pro, Gaps and Cracks Insulating Foam by Dow Chemical Company, or comparable product by another Manufacturer.
      c. Firmly pack gaps and voids above the stud track with Mineral Fiber Batt insulation (Refer to Division 07 or 09 for Thermal or Acoustical Insulation). Caulk gun or trowel apply, and trowel coat to form a continuous seal between top of sheathing and bottom of deck with USG "Acoustical Sealant", or comparable product by Tremco or Pecora. For thermal-only (non-acoustical) applications, apply sealant to exterior or unconditioned side of partition. For acoustical applications, apply sealant to both sides of the partition.
      d. Contractor shall confirm chemical compatibility of sealant used with adjacent air barrier system(s).
Within wall sealant is used at perimeter wall construction, apply in manner to achieve a continuous air seal from top of air barrier system to bottom of deck, without gaps or voids. Confirm acceptable detail(s) with air barrier system Manufacturer. Refer to Division 07 “Air Barrier” Section(s) for air barrier materials.

**f.** Where top of wall sealant will be exposed in finished interior space, apply in a manner to produce an aesthetic finished result, flush with the face of wall. Cut spray foam flush with face of wall and neatly trowel acoustical sealant to a semi-smooth finish, and remove excess material.

**E.** Sealant for Exterior Concrete Paving and Sidewalk Joints: Two part urethane (self leveling) sealant equal to "MasterSeal SL-2" by Sonneborne / BASF Chemical Co., "Ureexpan NR-200" by Pecora, or "THC-900" Tremco. Provide non-sag product at joints in vertical curbs, equal to "MasterSeal NP-2" by Sonneborne / BASF.

**F.** Caulking for Interior Joints: One part acrylic latex sealant equivalent to "AC-20" by Pecora, "Tremflex 834" by Tremco, "Acrylic Latex" caulk by DAP, or "Sonolac" by Sonneborn.

**G.** Caulking for Countertop Joints: One-part clear silicone sealant, 860 by Pecora, or equal.

**H.** Precompressed Expanding Foam Sealant: Shall be Gray "Willseal 600" as manufactured by "Tremco", Beachwood, Ohio or approved equal.

**I.** Sealant for Gypsum Board joints for Acoustic Construction: USG "Acoustical Sealant" or equal by Tremco or Pecora.

**J.** Joint Backing: ASTM C1330, Non-staining closed cell polyethylene foam rod oversized 30% to 50%, equal to "MasterSeal 920" by BASF.

**K.** Foam Backer Rod for Acoustic Construction: ASTM C1330, Closed cell polyethylene, Acceptable Manufacturers: ITP, Nomeco, or approved equal. (Available through Tom Brown, Inc. 800-446-2298)

**L.** Solvents and Cleaning Agents: Of a type specifically recommended by sealant manufacturer.

**M.** Sealant for Re-glazing: Medium modulus silicone sealant shall be Tremco's "Spectrem 2", or approved equal. Color as selected by Architect.

**N.** Sealants around storefront window and door systems, reference “Division 08 Aluminum Folding Doors, Storefront and Window.”

**PART 3 - EXECUTION**

**3.01** **COORDINATION AND INSPECTION**

A. Coordinate sealing requirements with all trades for complete fire resistive, thermal, moisture, aesthetic or acoustical barriers and trim.

B. Applicator shall examine surfaces receiving sealant or caulking for any defects or joint sizes which would not structurally perform or for any unusual conditions which would interfere with proper installation of sealant or caulking.

**3.02** **PREPARATION**

A. Prepare joints in accordance with Manufacturer’s instructions.

B. Thoroughly clean all joints removing all foreign matter such as dust, oil, grease, dirt or other loose particles. Provide and apply non-staining primer as required by conditions and sealant manufacturer.

C. When primer is dry, compress backup and insert into joint leaving 1/4" to surface open for joint sealing or leave open 1/2 of joint width, but not less that 1/4".
D. Completely cut smooth and remove projection of existing gasket and/or sealant material at door and window framing to remain to achieve sound substrate for application.

3.03 APPLICATION

A. It is the intent and purpose and interpretation of this specification that in all areas, joints sealed shall be rendered structurally sound and impervious to the passage of water, moisture and dust.

B. Follow sealant manufacturer's instructions regarding mixing, surface application, priming and application procedure.

C. Sealant shall be applied under pressure with a hand or power activated gun having a nozzle of proper size to entirely fill joint void and shall be forced into joints with sufficient pressure to expel air and fill the joints solidly. All joint surfaces shall be neatly tooled to a smooth surface, free of wrinkles and result in a flush joint when dry.

D. Apply sealants when the ambient temperature is between 40° and 100° F.

E. All junctures between countertops, back splashes and walls shall be caulked with silicone sealant providing a sanitary tight joint.

F. All junctures between piping and substrate of partitions, floors and ceiling shall be caulked.

G. Precompressed expanding foam sealant shall be installed per manufacturer's requirements at all vertical expansion joints as noted on Drawings.

H. Apply sealant bead at least 1/2 inch thick under each edge of threshold. Remove excess and neatly point.

I. Apply sealant between exterior veneers and coping on outside face of exterior wall.

J. Caulk perimeter of window frame, door frame or other items penetrating, intersecting or abutting walls, ceilings, floors, etc.

K. Prime surface as required and apply sealant at all glazing, at metal to metal and glass to metal joints within the system.

L. Apply bead of sealant at base of wall board.

M. Furnish and install acoustical sealant at the following locations:
   1. All penetrations of partition, wall, and floor construction by ductwork, conduit, piping, or structure.
   2. All termination of partitions enclosing Noise Critical Spaces to abutting construction (e.g. partitions, structure, etc.)
   3. Both sides of door frames to abutting construction where doors are scheduled to have acoustical seals.
   4. Both sides of window frames to adjacent construction
   5. Perimeter of and penetrations through sound isolating ceilings, roof systems, and floor systems.
   6. Foam sealant at top of wall to underside of roof/floor deck, at partitions to deck that are indicated to be constructed to a STC rating.

N. Backer Rod shall be used in all joints, product to be constructed of closed cell foam, or appropriate resilient material for sealant. Dimension shall be minimum 30% greater than joint width, unless otherwise indicated on details.

O. Fill paving sealant full width of joint, and to within 1/8" of paving surface.

3.04 CLEANING
A. Clean adjacent surfaces free of sealant or soiling resulting from this work as work progresses. Use solvent or cleaning agent as recommended by sealant manufacturer. All finished work shall be left in a neat, clean condition.

END OF SECTION 07 92 00
PART 1   GENERAL

1.1 SUMMARY

A. Section Includes:
1. Joint sealers for other sections referencing this Section.
2. Joint backup materials.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):

1.3 SUBMITTALS

A. Submittals for Review:
1. Product Data: Indicate sealers, primers, bond breakers, and accessories proposed for use.
2. Samples:
   a. 1/2 x 1/2 x 3 inch long joint sealer samples showing available colors.
   b. 6 inch long joint backup material samples.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum 2 years experience in work of this Section.

1.5 PROJECT CONDITIONS

A. Do not apply sealers at temperatures below 40 degrees F unless approved by sealer manufacturer.

PART 2   PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. BASF Building Systems. (www.buildingsystems.basf.com)
2. Dow Corning Corp. (www.dowcorning.com)
3. GE Silicones. (www.siliconeforbuilding.com)
4. Pecora Corp. (www.pecora.com)
5. Sika Corp. (www.sikausa.com)
6. Tremco, Inc. (www.tremcosealants.com)
B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Joint Sealer Type 1:
   1. ASTM C920, Grade P, multiple component polyurethane type, self-leveling and slope grades.
   3. Color: To be selected from manufacturer's full color range.
   4. Uses: Joints in horizontal surfaces subject to pedestrian or vehicular traffic.

B. Joint Sealer Type 2:
   1. ASTM C920, Grade NS, single component silicone type, nonstaining, non sag.
   2. Movement capability: Plus or minus 50 percent.
   3. Color: To be selected from manufacturer's full color range.

2.3 ACCESSORIES

A. Primers, Bondbreakers, and Solvents: As recommended by sealer manufacturer.

B. Joint Backing:
   1. ASTM C1330, bi-cellular polyethylene foam, preformed round joint filler, non absorbing, non staining, resilient, compatible with sealer and primer, recommended by sealer manufacturer for each sealer type.
   2. Size: Minimum 1.25 times joint width.

2.4 MIXES

A. Mix sealers in accordance with manufacturer's instructions.
   1. Mix with mechanical mixer; prevent air entrainment and overheating.
   2. Continue mixing until color is uniform.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove loose and foreign matter that could impair adhesion. If surface has been subject to chemical contamination, contact sealer manufacturer for recommendation.

B. Clean and prime joints in accordance with manufacturer's instructions.

C. Protect adjacent surfaces with masking tape or protective coverings.

D. Calculate joint dimensions in accordance with ASTM C1472.

3.2 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Install sealers and accessories in accordance with ASTM C1193.
C. Install joint backing to maintain required sealer dimensions. Compress backing approximately 25 percent without puncturing skin. Do not twist or stretch.

D. Use bondbreaker tape where joint backing is not installed.

E. Fill joints full without air pockets, embedded materials, ridges, and sags.

F. Tool sealer to smooth profile.

G. Apply sealer within manufacturer’s recommended temperature range.

3.3 CLEANING

A. Remove masking tape and protective coverings after sealer has cured.

B. Clean adjacent surfaces.

END OF SECTION
SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY
A. Section Includes:
   1. Provide hollow metal doors and frames as shown on the Drawings and as herein specified.
B. Related Sections include the following:
   1. Division 04 Section - Masonry.
   2. Division 06 Section - Rough Carpentry.
   3. Division 07 Section - Sheet Metal Flashings and Trim.
   4. Division 08 Section - Flush Wood Doors.
   5. Division 08 Section - Door Hardware.
   6. Division 08 Section - Glazing.
   7. Division 09 Section - Gypsum Board.
   8. Division 09 Section - Painting.

1.03 QUALITY ASSURANCE
A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
C. Design Criteria: Doors and frames noted to have a specific hourly label, shall be Underwriter's Laboratories, Inc. labeled construction shall bear the required UL label.
D. Pre-Installation Conference: Conduct conference in compliance with requirements in Division 01 with attendance by representatives of Supplier, Door and Door Hardware Installer(s), Security System Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.04 SUBMITTALS
A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, STC ratings, hardware reinforcements, profiles, anchors, insulation values, fire-resistance rating, and finishes.
B. Product Schedule: For hollow-metal doors and frames, 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.
C. Manufacturer shall furnish a certificate to the Owner evidencing that materials delivered meet the labeled and/or fire resistive construction requirements.
D. Shop drawings and details based on the Contract Documents shall be submitted to the Architect for review prior to fabrication of materials. Shop drawings shall indicate:
1. Elevations of each door design.
2. Insulation values for exterior doors and frames.
3. Hardware mounting heights
4. Details of doors, including vertical and horizontal edge details and metal thicknesses.
5. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
6. Locations of reinforcement and preparations for hardware.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.
10. Details of conduit and preparations for power, signal, and control systems.

E. Concurrent Review: Submit submittals under this Section together with all other door and door hardware submittals for concurrent review of door openings.

1.05 Warranty
A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

1.06 Product Delivery, Storage and Handling
A. Delivery of Material: Individually packaged in cartons, completely protecting frames.
B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
C. Frames shall be stored under cover on wood sills that will prevent rust and damage. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity. Do not use un-vented plastic.

1.07 Job Conditions
A. Coordination
1. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.
2. The Contractor shall provide door and frame manufacturer with an approved hardware schedule, templates and handle for all doors. Contractor shall advise door and frame manufacturer of any changes after information has been forwarded.
3. Contractor will be completely responsible for coordination of information between hardware, door and frame manufacturer. Contractor shall coordinate throat dimensions and clearance at thresholds and sill conditions with adjacent construction. Any materials not properly coordinated shall be replaced by the Contractor at his own expense.
4. Contractor shall coordinate frame preparation requirements with the access control installer prior to preparing submittals.
5. Coordinate reinforcing and preparation for hardware at doors with lites, including lite frames. Requirements of Texas Accessibility Standards for maximum height above floor of the bottom of the vision lite may likely require door hardware to be mounted slightly lower than standard height in order to avoid a conflict between hardware and door lite frames. Pay particular attention to exit device mounting.

PART 2 - PRODUCTS
2.01 MATERIALS
A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 metallic coating.
C. Door Frame Anchorage Devices: ASTM A 653/A, Commercial Steel (CS), Type B, with minimum G60 metallic coating. Provide with minimum of 6 wall anchors and 2 adjustable base anchors, manufacturer's standard design. Provide UL anchors as required. Contractor is responsible to coordinate anchor types required with adjacent construction.
1. Use metal tee anchors at frames in CMU masonry unless otherwise noted.
D. Exterior and Interior Door Frames: Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8, for physical performance level, and HMMA 867 for door construction. Furnished with 2" faces and 5/8" stops. Strike jambs provided with 3 factory installed rubber bumpers, and two per door leaf at head of pair door frames. Provide UL rating as required. Frames fabricated of quality 16 gauge annealed steel. Exterior frames to have A60 coating. Interior frames can be standard CRS.
1. Removable stops at exterior frames located at interior side of frames for security and waterproofing.
2. Removable stops at interior frames located at interior (room) side of interior frames.
E. Flush Doors: ANSI/SDI A250.8, 1-3/4" Flush type door with no visible edge seams. Reinforcements provided for all hardware. Doors mortised for hardware. Provide louvers and fire rating as required.
1. Interior Doors: Faces constructed of quality annealed steel as follows:
   a. HM-Typical Interior, except where noted otherwise: Heavy Duty (Level 2), 18 gauge steel. Steel stiffened laminated core with fiberglass filler with no stiffener face welds, in compliance with HMMA 867 "Laminated Core".
      1) Provide 22 gauge steel-stiffeners at 6 inches on-center internally welded at 5" on-center to integral core assembly, No stiffener face welding is permitted.
2. Exterior doors, and doors between conditioned and unconditioned or heated only spaces, shall have minimum R factor of 3.4 including insulated door, thermal-break frame and threshold, and flush closing channel at top rail. Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 “Laminated Core”.
   a. Extra Heavy Duty (Level 3), 16 gauge steel at exterior doors
3. Use other type(s) of steel stiffened cores may be used where required to achieve indicated R-values, STC ratings, and fire ratings, as approved by Architect.
4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
5. Hardware Reinforcements: Shop Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
6. Door louvers: Provide manufacturers standard flush louver. Refer to Division 08, Section "Flush Wood Doors".
F. Divided Lite Door: 16 Gauge, 1-3/4" x 5" tubular top and side stiles and 10" bottom rail with mitered, face-welded corners. Doors shall be mortised, reinforced, drilled and tapped to receive mortise hardware. Door shall be similar to Ceco "Imperial", or approved equal. Provide insulated metal panel or 1/4" tempered glass as shown on drawings.
G. Door Mullion: Provide complete heavy duty mullion at each pair of hollow metal doors indicated in door types to receive center mullions, except where removable mullions are indicated in the hardware schedule.
1. Refer to Division 08, Section "Door Hardware" for doors to receive removable mullions. Provide filler blocks at removable mullions except where the frame profile provides support behind the full width of the mullion bracket at head conditions.

H. Accessory Materials: Provide complete fasteners, miscellaneous materials and accessories as required for complete installation including but not necessarily limited to the following:
   1. Grout mix shall provide a 4" maximum slump consistency, hand troweled in place. Grout mixed to a thin "pumpable" consistency shall not be used.
   2. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.02 LITE OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.03 FABRICATION

A. Frames shall have all joints mitered, continuous full welded and ground smooth. No putty or filler permitted at joints.

B. All door frames mortised for 1-1/2 pair 4-1/2 x 4-1/2 standard weight hinges. Frames of 48" width shall have 2 pair butts. (Re: Door Schedule and Hardware Schedule for Number and Location.) Frames mortised and reinforced for hinges, (7 ga. 1-1/4" x 10" min.), strikes, (12 gauge steel), and surface applied hardware, (12 ga. steel), as required.

C. All door frames shall be prepared for installation of silencers.

D. Hollow Metal Frames:
   1. Welded Frames: Frames shall have all joints mitered, continuous full welded and ground smooth. No putty or filler permitted at joints Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
      a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
   2. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
   3. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
   4. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
   5. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
6. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c.
7. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
8. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Door Mullion: Provide complete heavy duty mullion at each pair of hollow metal doors except where removable mullions are indicated in the hardware schedule.
   1. Refer to Division 08, Section "Door Hardware" for doors to receive removable mullions. Provide filler blocks at removable mullions except where the frame profile provides support behind the full width of the mullion bracket at head conditions.

F. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
   1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
   2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
   3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
   4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
   5. Coordinate reinforcing and preparation for hardware at doors with lites including lite frames. Requirements of Texas Accessibility Standards for maximum height above floor of the bottom of the vision lite may likely require door hardware to be mounted slightly lower than standard height in order to avoid conflict between hardware and door lite frames. Pay particular attention to exit device mounting.

2.04 FINISH

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
B. Doors and Frames for exterior openings shall be galvanized before primer is applied using a hot-dip coating of zinc.
C. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.
D. Field Painting: Refer to Division 09, Section “Painting”.

PART 3 - EXECUTION

3.01 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. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Check for coordination with electrical preparation, and other coordination items as identified in Part 1 of these specifications, and in the pre-installation conference.

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

3.02 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.03 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. Anchor ceiling struts to construction above with fasteners to suit conditions. Brace frames as necessary until built into permanent construction.

C. Exercise extreme care when installing door frames. All door frames which are installed out of plumb, distorted and not level or in a manner which does not permit proper installation of doors, must be removed and replaced with new frames in a manner satisfactory to the Architect.

D. Clearances:
   1. Non-Fire-Rated Standard Steel Doors:
      a. Allow maximum of 1/16" clearance at head and jamb.
      b. Allow maximum of 1/2" clearance at floors.
      c. Allow maximum of 1/4" clearance at thresholds.
   2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

E. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.04 ADJUSTING, CLEANING AND PROTECTION

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.
   1. Refer to Division 01, “Substantial Completion Readiness Checklist” for additional list of final checks prior to requesting inspection.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.
D. Protect metal doors and frames and their finishes from damage and detrimental soiling during the remainder of construction.

1. Repair and repaint hollow metal that is damaged or soiled, to eliminate evidence of damage, in a manner acceptable to Architect. Replace components that cannot be repaired.

E. Clean doors and frames prior to inspection for substantial completion. Touch up paint finish as required. Clean with products that will not damage finishes.

END OF SECTION 08 11 13
SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Solid-core doors with wood-veneer faces.
   2. Factory finishing of flush wood doors.
   3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Sections:
   1. Division 04 Section "Unit Masonry Assemblies".
   2. Division 06 Section "Rough Carpentry".
   3. Division 08 Section "Hollow Metal Doors and Frames".
   4. Division 08 Section "Door Hardware".
   5. Division 08 Section "Glazing" for glass view panels in flush wood doors.
   6. Division 09 Section "Gypsum Board".

1.03 ACTION SUBMITTALS

A. Concurrent Review: Submit all door-related submittals together for concurrent review.

B. Product Data: For each type of door indicated. Include details of core and edge construction, STC acoustical rating, insulating R-value, hourly fire rating, louvers, and trim for openings. Include factory-finishing specifications.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
   1. Indicate dimensions and locations of mortises and holes for hardware.
   2. Indicate dimensions and locations of cutouts.
   3. Indicate requirements for veneer matching.
   4. Indicate doors to be factory finished and finish requirements.
   5. Indicate fire-protection ratings for fire-rated doors.

D. Samples for Initial Selection:
   1. For factory-finished doors.
   2. Manufacturer's samples or selectors for louvers, frames, and other prefinished materials as applicable.

E. Samples for Verification:
   1. For each wood species and transparent finish, provide set of at least three 12”x 12” samples showing the full range of color and grain to be expected in the finished work.

1.04 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.
1.05 QUALITY ASSURANCE
A. Source Limitations: Obtain flush wood doors from single manufacturer.
B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
C. Preinstallation Conference: Conduct conference at Project Site to comply with Division 01, Section "Project Management and Coordination".

1.06 DELIVERY, STORAGE, AND HANDLING
A. Comply with requirements of referenced standard and manufacturer's written instructions.
B. Deliver doors to building after wet trades have been completed and building is within normal occupancy humidity conditions. Doors shall be delivered in manufacturer's name and identifying symbol on covering. Doors shall be stored flat with protective coverings provided to protect surfaces. Doors shall not be dragged over one another.
C. Mark each door on top or bottom rail with opening number used on Shop Drawings.

1.07 PROJECT CONDITIONS
A. Comply with Manufacturer's environmental limitations.
B. Coordination:
   1. The Contractor shall provide door manufacturer with approved hardware schedules, templates and hand for all doors. Contractor shall advise door manufacturer of any changes after information has been forwarded. Contractor will be completely responsible for coordination between hardware, door and frame manufacturers. Any materials not properly coordinated shall be replaced by the Contractor at his own expense.
   2. Door manufacturer shall be responsible for properly coordinating information received by him so that doors are properly finished, machined and ready to hang.

1.08 WARRANTY
A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
      b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
   2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. VT Industries Inc.
   2. Masonite Architectural
   3. Curtis Corp.
   4. Graham; a Masonite company.
   5. Haley Brothers, Inc.
2.02 DOOR CONSTRUCTION, GENERAL
A. WDMA I.S.1-A Performance Grade:
   1. Heavy Duty unless otherwise indicated.
B. Structural-Composite-Lumber-Core Doors:
      a. Screw Withdrawal, Face: 700 lbf.
      b. Screw Withdrawal, Edge: 400 lbf.

2.03 VENEERED-FACED DOORS FOR TRANSPARENT FINISH
A. Finish for Veneer-Faced Doors:
   1. Grade: Premium, with Grade A faces.
   2. Species: Mahogany.
   6. Assembly of Veneer Leaves on Door Faces: Balance match.
   7. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
   8. Room Match: Match door faces within each separate room or area of building.
   9. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
B. Interior Solid-Core Doors:
   1. Exposed Vertical Edges: Same species as faces.
   2. Core: Structural composite lumber.
   3. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.
   4. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.04 LOUVERS AND LIGHT FRAMES
A. Metal Louvers:
   1. Blade Type: Vision-proof, inverted V.
   2. Metal and Finish: Extruded aluminum with black, Class II, color anodic finish, AA-M12C22A32/A34.

2.05 FABRICATION
A. Prefit and pre-machine wood doors at the factory.
B. Comply with the tolerance requirements of NWMA for prefitting. Machine doors for hardware requiring cutting of doors. Comply with final hardware scheduled and door frame shop drawings, and with hardware templates and other essential information required to ensure proper fit of doors and hardware.
C. Take accurate field measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with machining in the factory.
D. Openings: Cut and trim openings through doors in factory.
   1. Light Openings: Trim openings with moldings of material and profile indicated.
   2. Provide flush edgings for wood doors receiving panic devices or other hardware where typical molding would conflict with hardware. Coordinate with door hardware.
   3. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."
2.06 **SHOP PRIMING**
   A. Trim and touch-up for Transparent Finish: Shop prime doors light beads and other trim pieces with stain (if required), other required pretreatments, and first coat of finish as specified in Division 09 Section "Painting". Seal all four edges, edges of cutouts, and mortises with first coat of finish.

2.07 **FACTORY FINISHING**
   A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
   1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
   B. Finish doors at factory.
   C. Transparent Finish:
      1. Grade: Premium.
      2. Finish: WDMA TR-4 conversion varnish.

**PART 3 - EXECUTION**

3.01 **EXAMINATION**
   A. Examine doors and installed door frames before hanging doors.
      1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
      2. Reject doors with defects.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**
   A. Hardware: For installation, see Division 08 Section "Door Hardware."
   B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
      1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
   C. Clearance Tolerances for Factory Fitted Doors: Align in frames for uniform clearance at each edge.
      1. Provide 1/8 inch at heads, jambs, and between pairs of doors.
      2. Allow maximum of 3/16" over threshold or saddle.
      3. Allow maximum of 1/2" over decorative floor coverings.
      4. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
   D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.03 **ADJUSTING**
   A. Operation: Re-hang or replace doors that do not swing or operate freely. Replace damaged material.
   B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.
C. Protect doors as recommended by door manufacturer to ensure that doors will not be damaged at time of Substantial Completion.

END OF SECTION 08 14 16
SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY
A. This Section includes the following:
   1. Provide all access doors and frames for walls and ceilings as indicated in Drawings and as required for access to equipment and by authorities having jurisdiction, whether or not locations for access doors and frames are specifically indicated in Drawings.
B. Related Sections include the following:
   1. Division 06 "Rough Carpentry" for coordination of wood blocking.
   2. Division 09 Section "Gypsum Board" for gypsum board assemblies.
   3. Division 09 Section "Acoustical Ceilings" for suspended acoustical tile ceilings.
   4. Division 23 Section "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.03 SUBMITTALS
A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

1.04 QUALITY ASSURANCE
A. Source Limitations: Obtain access doors and frames of each type through one source from a single manufacturer.
B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
   1. NFPA 252 for vertical access doors and frames.
   2. ASTM E 119 for horizontal access doors and frames.
C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.05 COORDINATION
A. Verification: Coordinate with other trades to determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, electrical, or other concealed work.
   1. Size panels as required by controls to be accessed. Provide adequate sizes to service equipment accessed by doors and panels, and acceptable to authorities having jurisdiction.
2. For replacement of access doors in existing construction, field measure to match existing opening sizes.

1.06 PRODUCT DELIVERY AND STORAGE
A. Deliver products in manufacturers original packages, clearly marked with brand name and model number.

1.07 WARRANTY
A. Manufacturer shall guarantee against defects in material and workmanship for a period of one years minimum.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Access Doors:
      a. Acoustical Products, Inc.
      b. Acudor Products, Inc.
      c. Bilco
      d. Babcock Davis
      e. J. L. Industries, Inc.
      g. Larsen's Manufacturing Company.

2.02 WALL AND CEILING ACCESS DOORS AND PANELS
A. Ceiling Access Door (where passage is required for service access) at ceilings: Flush style Metal Access panel with perforated galvanized metal frame flanges for drywall tape and bedding, concealed non corroding two point pin hinge, and cylinder lock & key, equal to Acudor Products, Inc., DW5040
   1. Size: As indicated and as required for access, provide custom size if required size is not standard.
   1. Locations: Wall surfaces and gypsum board ceilings. Install at all location where valves or controls are concealed within walls, whether shown on the drawings or not.
   2. Door: Minimum 0.060-inch thick, 16 gauge sheet metal, set flush with exposed face flange of frame.
   3. Size: As required for access, provide custom size if required size is not standard.
   4. Frame: Minimum 0.060-inch thick, 16 gauge sheet metal with nominal 1-inch-wide, surface-mounted trim.
   5. Fire rated to match adjacent construction when located in fire rated construction.
   6. Hinges: Continuous piano hinge.
   7. Latch: Screwdriver-operated cam latch.
   8. Finish:
      a. Satin stainless steel at tile, restrooms, and other wet locations.
      b. Shop primed steel for field applied painting in other wall locations. Color to match adjacent finish or per architect’s direction.

PART 3 - EXECUTION

3.01 INSPECTION
A. Examine areas to receive door and frame to insure work of preceding trades is completed. Check surfaces to see that they are plumb in place, free from grease, oil or other debris which would affect proper installation. Application constitutes acceptance of substrate conditions.

3.02 INSTALLATION
A. Comply with manufacturer's written instructions for installing access doors and frames.
B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.
D. Installation: All access panel locations in Noise Critical Spaces shall be installed only where indicated on drawings. Location of additional proposed access panels shall be submitted by Contractor for approval.

3.03 ADJUSTING AND CLEANING
A. Adjust doors and hardware after installation for proper operation.
B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13
SECTION 08 41 15 ALUMINUM FOLDING DOORS, STOREFRONT AND WINDOW

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Provide storefront (including aluminum doors and hardware), framing complete with glazing as shown on the drawings and as herein specified.

B. Related Sections:
   1. Division 05 Section - "Metal Fabrications".
   2. Division 06 Section - "Rough Carpentry".
   3. Division 07 Section - "Sheet Metal Flashing and Trim".
   4. Division 07 Section - "Joint Sealants".
   5. Division 08 Section - "Door Hardware".
   6. Division 08 Section - "Glazing".
   7. Division 12 Section - "Manual Roller Shades".

1.03 DEFINITIONS

A. WDMA – Window and Door Manufacturer’s Association
B. AAMA – American Architectural Manufacturer’s Association
C. CSA – Canadian Standards Association
D. NFRC – National Fenestration Rating Council
E. AAC – Aluminum Anodizers Council
F. CPSC – Consumer Produce Safety Commission

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
   1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
   2. Dimensional tolerances of building frame and other adjacent construction.
   3. Failure includes the following:
      a. Deflection exceeding specified limits.
      b. Thermal stresses transferring to building structure.
      c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
d. Glass breakage.
e. Noise or vibration created by wind and by thermal and structural movements.
f. Loosening or weakening of fasteners, attachments, and other components.
g. Sealant failure.
h. Failure of operating units.

C. Structural Loads:
1. Wind Loads: As required by authorities having jurisdiction.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to
glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite
or an amount that restricts edge deflection of individual glazing lites to 3/4 inch,
whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch,
whichever is smaller.
   a. Operable Units: Provide a minimum 1/16 inch clearance between framing members
      and operable units.

E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM
   E 330 as follows:
   1. When tested at positive and negative wind-load design pressures, systems do not
      evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, systems,
      including anchorage, do not evidence material failures, structural distress, and permanent
      deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

F. Air Infiltration:
   1. Fixed Framing: Provide aluminum-framed systems with maximum air leakage through
      fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested
      according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 psf.
   2. Entrance Doors: Maximum air leakage of 1.0 cfm/sq. ft. for pair of doors, and maximum
      of 0.5 cfm/sq. ft. for a single door, at a static air pressure differential of 6.24 psf.

G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not
   evidence water penetration through fixed glazing and framing areas when tested according to
   ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load
   design pressure, but not less than 8 psf.

H. Energy Performance: Certify and label energy performance according to NFRC as follows:
   1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor
      of not more than 0.50 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
   2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain
      coefficient of no greater than 0.25 as determined according to NFRC 200.

I. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements
   resulting from the following maximum change (range) in ambient and surface temperatures.
   Base engineering calculation on surface temperatures of materials due to both solar heat gain
   and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
   2. Interior Ambient-Air Temperature: 75 deg F.

J. Brake metal oil canning that may be caused by design wind loads. Additionally, thickness
   may be greater but shall not be less than minimum thicknesses as specified elsewhere in these
   specifications, or minimum thicknesses as indicated in Drawings. Contractor shall include
necessary thicknesses in his bid for required Brake Metal: Provide in thicknesses as required to prevent oil canning, including for exterior

1.05 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
C. Shop drawings and details based on the Contract Documents submitted to the Architect for review. Include plans, elevations, sections, full-size details, and attachments to other work. Show connection to and continuity with adjacent thermal, weather, and air barriers.
D. Samples for verification:
   1. Submit three samples of each required aluminum finish on aluminum plates or extrusions.
E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance and bifold door hardware, as well as procedures and diagrams. Coordinate final door hardware schedule with doors, frames, door hardware, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware. Coordinate with hardware requirements of section 08 71 00 Door Hardware. Submit for concurrent review with other door and hardware submittals.

1.06 INFORMATIONAL SUBMITTALS
A. Qualification Data: For Installer.
B. Professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.
C. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
   1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront. Compliant with local code requirements and as specified herein, whichever is more stringent.
D. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency, or by a qualified testing agency.
E. Sample Warranties: For special warranties.

1.07 CLOSEOUT SUBMITTALS
A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.
   1. Provide manufacturer's maintenance instructions that include recommendations for periodic cleaning and maintenance of all components.

1.08 QUALITY ASSURANCE
A. Fabricator and Installer: Shall have a minimum of 5 years experience on projects of similar size and scope. Installer shall be approved by Manufacturer.
B. Industry Standards:
   1. AAMA/WDMA/CSA 101/1.S.2-A440 Specifications, CW PG50
   2. NFRC 100 for U-factor and NFRC 200 for Solar Heat Gain Coefficient (SHGC)
8. ASTM E 547 - Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.

1.09 DELIVERY, STORAGE, AND HANDLING
A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
B. Packing, Shipping, Handling, and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
C. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle material and components to avoid damage. Protect curtain wall material against damage from elements, construction activities, and other hazards before, during and after curtain wall installation.

1.10 PROJECT CONDITIONS
A. Field Measurements: Verify actual dimensions and locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.11 GUARANTEE AND WARRANTY
A. Installer shall submit a written guarantee to the Owner, guaranteeing storefront system for a period of 2 years against leaks and defects in the system.
B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
   1. Structural failures including, but not limited to, excessive deflection.
   2. Noise or vibration caused by thermal movements.
   3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   4. Water leakage through fixed glazing and framing areas.
   5. Failure of operating components.
   6. Warranty Period: Ten years from date of Substantial Completion.
C. Operable Door and window manufacturer's warranty shall provide for a period of 2 years from date of Substantial Completion. All hardware installed by manufacturer shall be covered by warranty.
D. Manufacturer's Finish Warranty: Manufacturer's standard limited warranty against fade, chalk, crack, check, peel, and failure of coatings to adhere to metal. Warranty duration as follows:
1.12 MAINTENANCE MATERIALS
   A. Entrance Door Hardware:
      1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and
         maintenance instructions as needed for Owner's continued adjustment, maintenance, and
         removal and replacement of entrance door hardware.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
   A. Basis-of-Design Product: Series 600 Window Wall glazing system, thermally broken
      framing at exterior. as manufactured by Western Window Systems Company, 2200 E.
      Riverview Dr., Phoenix, AZ 85034, 877-268-1300.
      1. Requests for substitutions will be considered in accordance with provisions of Section 01
         60 00 - Product Requirements.

2.02 MATERIALS
   A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish
      indicated.
      1. Sheet and Plate: Commercial quality 6063-T5 alloy and temper extruded aluminum
         ASTM B 209.
      2. Component parts and accessories shall be made of aluminum alloy, plated steel, stainless
         steel, or nonmetallic materials to resist deterioration and corrosion.
      3. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
      5. Structural Profiles: ASTM B 308/B 308M.
      6. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
   B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer,
      complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation
      and pretreatment. Select surface preparation methods according to recommendations in
      SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
      1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
      2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
      3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.03 FRAMING SYSTEMS
   A. Framing Members and Brake Metal Fillers: Manufacturer's standard 4.5” deep extruded-
      aluminum framing members of thickness required and reinforced as required to support
      imposed loads.
   B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum or steel with
      nonstaining, nonferrous shims for aligning system components.
   C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining,
      nonbleeding fasteners and accessories compatible with adjacent materials.
      1. Use self-locking devices where fasteners are subject to loosening or turning out from
         thermal and structural movements, wind loads, or vibration.
      2. Reinforce members as required to receive fastener threads.
   D. Aluminum subsills: Provide Manufacturer’s Standard Stop Sills where framing sits on slab,
      and other locations as required by Manufacturer. Manufacturer’s subsill does not constitute a
      substitute for the continuous aluminum sill flashing with end dams as indicated in Drawings.
E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

F. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

G. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

   1. Color: Hillside Bronze

I. Glazing: All glass to comply with safety glazing requirements of ANSI Z97.1 and ANSI E774 for Insulating Glass, and ASTM Specification C1036, Standard Specification for Flat Glass
      a. Glazing Type: LoE-366 high performance glass.
      b. Enhanced Low-E Coating Used with Glazing Type Above: LoE-i89 enhanced winter performance glass.
      c. Overall Thickness: 1 inch nominal.
      d. U-Factor: 0.30
      e. SHGC: 0.24
      f. Manufacturer’s standard lite divider inserts as indicated on the drawings.

J. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

K. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

2.04 VENTING WINDOWS

A. Aluminum Windows: Subject to compliance with requirements, provide Series 670 Casement-Hinged thermally broken windows as manufactured by Western Window Systems, complying with AAMA/WDMA/CSA/101/I.S.2/A440, and as follows:
   1. Window Type: Outward-Projecting Casement
   2. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

B. Performance Requirements:
   1. Air Infiltration Per ASTM E 283: .06 cfm/sf at test pressure of 1.57 psf.
   6. Certifications:
         1) CW PG50 grade rating for casement windows.
      b. NFRC 100 for U-factor.
      c. NFRC 200 for Solar Heat Gain Coefficient (SHGC).

C. Frames and Sills: Thermally broken.
   1. Extruded aluminum, 6063-T5.
      a. Width: 16 to 42 inches (406 to 1067 mm) maximum.
      b. Height: 16 to 120 inches (406 to 3048 mm) maximum.
      c. Sloped Sill: for improved water drainage.
      d. Frame Depth: 4.5 inches (114 mm).
2. Stops: Glazing secured with extruded aluminum snap-in stops, removable for glazing and reglazing.
   a. Stepped profile with removable stops for re-glazing. Available in multiple dimensions. Accommodates glass sizes from .75 to 1 inch (19 to 25 mm) overall.
   b. Stops in arches are applied with exposed screws.
3. Construction: Structural frame extruded shapes with sash members that are full-hollow (tubular) extrusions.
   a. Frame members fitted and mechanically joined at corners with stainless steel screws and sealed with high-grade silicone sealant.
   b. Sash members mitered, mechanically joined with crimped aluminum corner keys, and sealed with high-grade silicone sealant.
4. Weatherstripping: Bulb vinyl and closed cell foam tape
5. Mullions: Between adjacent windows, fabricated of extruded aluminum matching finish of window units.
6. Fasteners, Anchors, and Clips: Nonmagnetic stainless steel, aluminum, or other noncorrosive material, compatible with aluminum window members, trim, hardware, anchors, and other components of window units. Fasteners shall not be exposed, except for attaching hardware.
   a. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.128 inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, spline grommet nuts.
7. Hardware: Manufacturer's standard stainless steel, as follows:
   a. Hidden Multi-Point Locking System: Windows 24 to 120 inches (610 to 3048 mm) high.
   b. Butt Hinges:
      1) Windows Less Than 36 inches (914 mm) High: Two.
      2) Windows From 36 up to 60 inches (914 to 1524 mm) High: Three.
      3) Windows From 60 up to 84 inches (1524 to 2134 mm) High: Four.
      4) Windows From 84 through 120 inches (2134 to 3048 mm) High: Five.
   c. Limit Devices: Concealed support arms with adjustable, limited, hold-open limit devices designed to restrict sash opening.
      1) Limit clear opening to 4 inches for ventilation; with custodial key release.
8. Manufacturer's standard lite divider inserts as indicated on the drawings.

D. Glazing: Match aluminum storefront system glazing.
E. Screening: Extruded aluminum frames finished to match the window's frame color. Attached to window with an easy-to-use concealed ball catch system.
   1. Mesh: 18 x 16 charcoal-colored vinyl-coated fiberglass mesh.
   2. Swing-Out Casements: Screens mount to window frame interior.
F. Finish: Match adjacent aluminum-framed entrances and storefront finish.

2.05 EXTERIOR SWINGING DOOR SYSTEMS
A. Single panel thermally broken swing-out doors mounted in a Series 900 frame as manufactured by Western Window Systems with Western Window Systems’ E9860 1.69” residential step threshold conforming to ASTM E283 for air infiltration, ASTM E547 for Water Penetration, ASTM E330 for Structural Performance
   1. Medium 4.71” stile with 4.18” top rail and 7.17” bottom rail with 4.5” deep thermally broken frame system and .75” stop for Duo-Pane glazing.
      a. Provide nonremovable glazing stops on outside of door.
   2. All frame members are neatly fitted and mechanically joined at the corners with stainless steel screws
3. Door rails (horizontal members) shall be designed to nest with stiles (vertical members) to eliminate daylight and shine at cut edge.
4. Door stiles shall be fabricated to achieve an interlock system that engages the rails and is secured with a tie rod assembly to ensure a permanent rigid connection at the top and bottom corners of the door panel.
5. Door panel stiles and rails shall have a nominal wall thickness of .125”.
6. Glazing will be secured with extruded aluminum snap-in stops that can be removed for re-glazing.
7. Manufacturer’s standard lite divider inserts as indicated on the drawings.

B. Glazing: Match aluminum storefront system glazing.
1. All glazing in doors shall be fully tempered.

C. Entrance Door Hardware: Factory install entrance door hardware provided by Manufacturer to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
1. Standard Type “A” multi-point locking hardware shall include a maximum-security plated steel lock case with latch bolt and lock bolt in one assembly, Eurostyle premium aluminum lever handles on the interior and exterior of all single doors.
2. A thumb turn shall be supplied on the interior and a Schlage 5-pin C keyway cylinder on the exterior.
3. The door shall be mounted to the frame using a continuous aluminum hing.
5. Weather-stripping / gasketing: Manufacturer's standard replacement stripping of Black Santoprene bulb at the doorframe stop, full perimeter on swing-out doors and at jambs, and head only on swing-in doors.
6. Doorframes shall be equipped with a stainless steel frame strike with dust box and Western Window Systems’ part E9860 1.69” tall, extruded aluminum threshold.
7. Exposed Hardware Finish: Stainless Steel or Brushed nickel finish per manufacturer standards.
8. Refer to Division 08, Section "Door Hardware" for more information.

2.06 EXTERIOR BI-FOLD DOOR SYSTEMS
A. Paired top hung, thermally broken, bi-fold panel sliding doors, Series 9500 system as manufactured by Western Window Systems compatible with Western Window Systems’ Series 900 storefront wall system.
1. 4.5” frame width and a 2.25” x 3.5” door stile
   a. Provide nonremovable glazing stops on outside of door.
2. Stainless steel head load carriers and heavy duty stainless steel carrier hinges.
3. Sealed stainless steel ball bearing roller system.
4. All frame members are neatly fitted and mechanically joined at the corners with stainless steel screws.
5. Door rails (horizontal members) shall be designed to nest with stiles (vertical members) to eliminate daylight and shine at cut edge.
6. Door stiles shall be fabricated to achieve an interlock system that engages the rails and is secured with a tie rod assembly to ensure a permanent rigid connection at the top and bottom corners of the door panel.
7. Door panel stiles and rails shall have a nominal wall thickness of .125”.
8. Glazing will be secured with extruded aluminum snap-in stops that can be removed for re-glazing.
9. Aluminum finish to match storefront system.
10. Manufacturer’s standard lite divider inserts as indicated on the drawings.
B. Glazing - Insulating glass conforms to ASTM E774 specification for Sealed Insulating Glass to match storefront system glazing.
   1. Insulated glass to match storefront system.
   2. All glazing in doors shall be fully tempered

C. Bi-Fold Door Hardware: Factory install all door hardware provided by Manufacturer to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes
   1. Ater barrier sills.
   2. Concealed active door leaf locking hardware shall be stainless steel
   3. Standard cylinder lock with Schlage 5-pin keyway
   4. Manual multi-point locking system with shoot bolts locking panels at head and sill
   5. Refer to Division 08, Section "Door Hardware" for more information.

2.07 ACCESSORY MATERIALS
A. Aluminum Trim: Provide brake metal trim in locations specifically shown in Drawings and other locations as required for complete installation. Thicknesses indicated in Drawings and specifications are minimum thicknesses regardless of minimum thickness to prevent oil canning. Provide greater thickness than indicated minimum thicknesses where required to prevent oil canning. Contractor is responsible to determine required thicknesses per delegated design requirements (refer to Part 1 of these specifications).

B. Anchoring Devices: Provide plates, angles, steel frame bracing, wind bracing, spacers, clips and other devices necessary to support aluminum framing and glass. Design of connections shall be fabricator's responsibility. Submit shop drawing for approval.

C. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."
   1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.08 FABRICATION
A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Profiles with solid back extrusions, or with filler plates, as required to receive membrane flashings at jamb flashings (locations where metal jamb flashing is not otherwise indicated).
   3. Accurately fitted joints with ends copeed or mitered.
   4. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
   5. Physical and thermal isolation of glazing from framing members.
   6. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.09 ALUMINUM FINISHES

A. Clear or Color Anodic Finish: AA-M12C22A31/A32/A34, AAMA 611, Architectural Class I Clear Anodic Coating.

B. Color: Hillside Bronze

C. Miscellaneous Steel Bracing (Concealed): One (1) shop coat of red oxide primer.

D. Source Quality Control: Representative samples of color anodized finish shall meet or exceed following tests: ASTM B224, thickness of coating; and ASTM B117, neutral salt spray.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.02 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
   1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to manufacturers' written instructions using concealed fasteners to greatest extent possible.

G. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" to produce weathertight installation.

3.03 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
   1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
   2. Alignment:
      a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
      b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on mockups and representative areas of glazed aluminum curtain walls.
   1. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-airpressure differential of 1.57 lbf/sq. ft.
      a. Representative Areas: For each system type, perform a minimum of three tests in areas as directed by Architect.
      b. Failed Tests: Perform one additional test at location selected by Architect for each failed test.
   2. Water Penetration: ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water infiltration to the building interior; any water intrusion to the building interior is a test failure.
      a. Locations: Same areas as air infiltration tests.
      b. Failed Tests: Perform one additional test at location selected by Architect for each failed test.

C. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
   1. Test a minimum of five areas on each building facade as directed by Architect.
   2. Repair installation areas damaged by testing.

D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
   1. Submit reports for each inspection, describing problems observed and corrections made.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating door hardware to function smoothly as recommended by manufacturer.
1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.

3.06 PROTECTION AND CLEANING

A. Protect aluminum framing and/or doors during construction by masking members with approved cardboard and paper as recommended by manufacturer. Take particular care in protecting openings and doors from damage during construction.

B. Upon completion, remove trimmings and other debris. Replace broken, scratched, chipped or other damaged glazing. Remove excessive sealant, mastic and other marks from adjacent surfaces, and wash with clean water. Cleaning of glazing must be done in strict compliance with manufacturer's recommendations.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.

END OF SECTION 08 41 15
SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Provide all finish hardware including door locks, lock cylinders, construction cores and final cores as required to complete all door work and other work described herein or on the drawings.
   2. The work in this section shall include the furnishing of all items of door hardware as hereinafter specified, or obviously necessary to complete the building, except those items which are specifically excluded from this Section of the specifications.

B. Related Sections include the following:
   1. Division 6 Section “Rough Carpentry”.
   2. Division 8 Section “Hollow Metal Doors and Frames”.
   3. Division 8 Section “Flush Wood Doors”.
   4. Division 8 Section “Aluminum Folding Doors, Storefront and Windows”.
   5. Division 10 Section “Signage”.
   6. Division 26 Section “Electrical”.
   7. Division 28 Section “Security Access Control”.

1.03 REFERENCES

A. References specified in this section subject to compliance as directed:
   3. IBC 2009 - International Building Code
   4. ADA - The Americans with Disabilities Act - Title III-Public Accommodations
   5. ANSI-A117.1-American National Standards Institute - Accessible and Usable Bldgs and Facilities
   6. ANSI-A156.5-American National Standards Institute - Auxiliary Locks and Associated Products
   7. UFAS - Uniform Federal Accessibility Standards
   8. UL - Underwriter's Laboratories, including UL-10B and UL-10C for Positive Pressure
   9. WHI - Warnock Hersey International Division of Inchcape Testing Services
   10. State and local codes including authority having jurisdiction.

A. Door Hardware in this section shall meet the following as established by the American National Standards Institute, Inc. (ANSI) which is sponsored by the Builders Hardware Manufacturers Association, Inc., (BHMA). Product tests are to be administered by the ETL Testing Laboratories, Inc., or other official testing laboratories which have been designed by BHMA for the testing of ANSI standards latest revision will be in effect.

B. Materials and Finishes

   1) Butts and Hinges                  BHMA 1301
      2) Locks and Lock Trim             ANSI A156.1
      3) Exit Devices                   ANSI A156.2
      4) Door Controls-Closers          ANSI A156.4
5) Auxiliary Lock & Assoc. Products ANSI A156.5
6) Architectural Door Trim ANSI A156.6
7) Template Hinge Dimensions ANSI A156.7
8) Door Controls-Overhead Holders ANSI A156.8

C. Listed Hardware: Hardware which is to be installed in or on fire labeled doors and frames, Class A or lesser, single or pairs shall be tested and listed by Underwriters Laboratories and/or Warnock Hersey Fire Laboratories Division. Exit devices which are to be used as panic hardware shall be tested and listed in Underwriters Laboratories "Accident Equipment List-Panic Hardware". All listed hardware shall be in compliance with National Fire Protection Association (NFPA) Standard Number 80 IBC current year adopted and be properly stamped or labeled for easy identification.

1.04 SUBMITTALS
A. Hardware Schedule: Submit complete hardware schedule (identifying each item as to manufacturer and number), shop drawings and product data to Architect for review prior to ordering of materials. This schedule shall be prepared using the "Sequence and Format for the Hardware Schedule" as approved and recommended by the Door and Hardware Institute (DHI). Include manufacturers cut-sheets on each item scheduled, coordinated with indexed letter or other designation as indicated in hardware schedule.
1. Submit data on closers indicating compliance with barrier-free codes.
2. Confirm coordination with door lights, including resolving possible conflicts of hardware or exit devices with locations of door lights as shown in Drawings. In the event of a conflict, include for Architect's consideration recommendations for a solution in compliance with applicable code requirements including Texas Accessibility Standards (TAS), for door lights requiring accessible height view (bottom of glass at 43" or lower).
3. Include confirmation and coordination with Owner's separate contracts for access control, security, and door bell and intercom systems for compatibility of hardware. Notify Architect in the event of conflict with specified hardware.
4. Include statement confirming coordination with wire mesh partitions as required for complete installation. Notify Architect in the event of apparent conflicts.

B. Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.

C. Certification Compliance: Submit any information necessary to indicate compliance to all these specifications as required.

D. Templates: The hardware supplier shall provide necessary templates and/or physical hardware to all trades requiring them in order that they may cut, reinforce or otherwise prepare their material or product to receive the hardware item. If physical hardware is required by any manufacturer, the hardware supplier shall ship to them such hardware via prepaid freight in sufficient time to prevent any delay in the execution of their work.

1.05 CLOSEOUT SUBMITTALS
A. Operations and Maintenance Data.
B. Maintenance Materials: Special tools as specified in Part 2 of these specifications

1.06 QUALITY ASSURANCE
A. All hardware items shall comply with ANSI Specifications, State of Texas Program for the Elimination of Architectural Barriers, Texas Accessibility Standards (TAS), and the Americans with Disabilities Act Accessibility Guidelines (ADAAG).
B. Hardware has been specified herein by manufacturer's name, brand and catalog numbers for the purpose of establishing a basis for quality, finish, design and operational function. To
insure a uniform basis of acceptable material, it is the intention that only manufacturer's items specified as "Acceptable and Approved" be furnished for use on this project. Obtain each type of hardware (latch and lock sets, hinges, exit devices closers) from single manufacturer, although several may be indicated as offering products complying with requirements.

1. Substitutions: Request for substitutions of items of hardware not listed as "Acceptable and Approved" shall be made to the Architect no later than thirty (30) after notice to proceed. Request for substitutions shall be accompanied by samples and/or detailed information as to the manufacturer of the product.

C. Accessibility Standards: Hardware shall be in conformance with Article 9102, Texas Civil Statutes, Elimination of Architectural Barriers Act of Texas.

1. Door Closers: The sweep period of closers shall be adjusted so that from an open position of 90 degrees, the door will take at least five seconds to move to an open position of approximately 12 degrees.

2. The maximum force for pushing or pulling open door shall be as follows:
   a. Sliding, folding, and interior hinged doors and gates: Not to exceed 5 lbf.
   b. Exterior hinged doors: Not to exceed 8.5 lbf.
   c. Fire doors: Adjusted to meet minimum closing force permitted by governing fire safety standards.

3. Federal Accessibility Standards: Hardware shall be in accordance with all requirements of the Americans With Disabilities Act (most current version).

D. Supplier: A recognized builders hardware supplier who has been furnishing hardware in the project's vicinity for a period of not less than two (2) years, and who is, or has in employment, a Hardware Consultant (AHC) in good standing as certified by the Door and Hardware Institute. This consultant shall have experience in the preparation of architectural hardware specifications, estimating, detailing, ordering, servicing of architectural hardware in all its branches and will be available at reasonable times during the course of the work for project hardware consultation to the Owner, Architect and Contractor. It is the hardware distributor's responsibility to coordinate the hardware specified to work with the Aluminum doors.

E. Pre-Installation Conference: Contractor shall schedule and hold a pre-installation conference that includes the Contractor, the Architect, and the Owner and/or his chosen representative, the Hardware Supplier, representatives as required for Owner's separate contracts related to door hardware installation, and all installers of hardware. Instructional meeting shall be conducted by the Hardware Supplier, covering proper installation of all items of hardware to be incorporated into the Project.

F. Keying Coordination Meeting: Contractor shall schedule and conduct a keying coordination meeting with Owner, and Owner's access control separate contract representative, to confirm final cores, keying, and door hardware coordination with the access control system. Conduct meeting with adequate time to coordinate any revisions including associated lead time, as required to avoid delays to construction schedule or substantial completion.

G. Installer Qualifications: Firm with a minimum of five years of documented experience in installing the types and grade of hardware being incorporated into the Project.

1. Upon request, provide three written references from Construction Administrators of previous projects for the Architect’s review before installation Contract or Subcontract is executed.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All items of hardware to be delivered to the jobsite shall be completely packaged with all necessary screws, bolts, miscellaneous parts, instructions and where necessary installation
templates for manufacturer's suggested installation. They are to be clearly labeled as to conveniently identify them and their intended location in the building.

B. Door Hardware shall be delivered to the Contractor by the hardware supplier. Direct factory shipments to the jobsite are not acceptable.
   1. A representative of the Contractor shall receive the hardware when delivered at the jobsite. A dry locked storage space complete with shelving, shall be set aside for the purpose of unpacking, sorting out, checking and storage.
   2. The hardware shall be jointly inventoried by representatives of the Contractor and the Hardware Supplier.
   3. Items damaged in shipment shall be replaced promptly and with proper material without additional cost to the Contractor or Owner.

C. All hardware shall be handled in a manner to minimize marring, scratching or damage.

D. Store and handle all materials strictly according to the manufacturer’s instructions.

1.08 COORDINATION, SEQUENCING AND SCHEDULING

A. Any part of the finish hardware required by the frame or door manufacturers or other suppliers that is needed in order to produce doors or frames is to be sent to those suppliers in a timely manner, so as not to interrupt job progress.

B. Schedule and conduct a keying coordination meeting with Owner's representative to confirm final keying. Schedule meeting with adequate time to coordinate final decisions and to have final cores and keys in time to avoid delays to substantial completion or owner occupancy.

1.09 PROJECT CONDITIONS

A. Coordination: Contractor responsible for coordination of information between hardware and manufacturers and other trades as required. Contractor shall advise each party of any changes during course of construction, including but not necessarily limited to the following:
   1. Door and frame manufacturers.
   2. For compatibility of thresholds provided under this Section with adjacent flooring conditions and transitions, as required for flooring transitions compliant with Texas Accessibility Standards (TAS).
   3. Floor and wall stops compatible with floor plan and construction type and finishes to which they attach. (In general, use wall stops where possible).
   4. Coordination of door hardware installation with glazing and louvers in doors as required to avoid installation, code, and handicap accessibility conflicts.
   5. All coordination related to door handing.
   6. Installation conditions for closers with adjacent construction and possible obstructions, and to allow for widest possible opening arc to allow to swing back to wall unless specifically indicated otherwise.
   7. Frame sizes coordinated with partition types indicated and required frame anchorages.
   8. Materials not properly coordinated replaced by Contractor at his expense.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
      a. Closers:
         1) Mechanical: 30 years.
      b. Automatic Operators: 2 year.
      c. Exit Devices:
1) Mechanical: 3 years.
2) Electrified: 1 year.
d. Locksets:
   1) Mechanical: 3 years.
   2) Electrified: 1 year.
e. Key Blanks: Lifetime

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

B. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated for special warranty.

PART 2 - PRODUCTS

2.01 FASTENERS

A. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.

B. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.

C. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.

D. Install hardware with fasteners provided by hardware manufacturer.

E. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
   1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.02 FINISH OF HARDWARE

A. Finish of items shall be as specified under the door hardware sets of this section.

B. The finish of items not specially mentioned above nor set forth in the schedule shall be US26D, unless shown otherwise.

2.03 HINGES

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Ives 5BB series
   2. Acceptable Manufacturers and Products: Hager, ABH

B. Requirements:
   1. Provide five-knuckle, ball bearing hinges conforming to ANSI/BHMA A156.1.
   2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
      a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
      b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
   3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
      a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
      b. Interior: Heavy weight, steel, 5 inches (127 mm) high
   4. 2 inches or thicker doors:
      a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
      b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.

6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.

7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.

9. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.

10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.

11. Provide mortar guard for each electrified hinge specified.

12. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

13. Provide continuous hinges where specified.

2.04 CYLINDRICAL LOCKS

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Schlage

B. Requirements:
   1. Provide cylindrical locks conforming to the following standards and requirements:
      a. ANSI/BHMA A156.2 Series 4000, Grade 1.
      b. UL 10C for 4'-0” x 10'-0” 3-hour fire door.
   2. Cylinders: Refer to “KEYING” article, herein.
   3. Provide cylindrical locksets exceeding the ANSI/BHMA A156.2 Grade 1 performance standards for strength, security, and durability in the categories below:
      a. Abusive Locked Lever Torque Test – minimum 3,100 inch-pounds without gaining access
      b. Cycle life - tested to minimum 10 million cycles per ANSI/BHMA A156.2 Cycle Test with no visible lever sag or use of performance aids such as set screws or spacers.
   4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
   5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
   6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
   7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
   8. Provide electrified options as scheduled in the hardware sets.
   9. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
      a. Lever Design: Dane.
b. Knurled finishes at openings serving rooms considered to be hazardous.

2.05 EXIT DEVICES

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Von Duprin

B. The maximum exit device projection shall be a maximum of 3-1/16” when activated. The exit device bar shall have an average minimum thickness of .201”. The pushpad surface shall be constructed of stainless steel; pushpads with plastic or Lexan coatings shall not be acceptable. Nylon bearings and stainless steel springs shall be used for long life and durability. Only torsion or compression springs are acceptable. Extension type springs are not acceptable. All device covers shall be of cast brass, deep drawn steel or stainless steel. Latchbolts shall be of stainless steel and shall have a deadlocking latch for extra security, except at full-glass or two-light glass doors requiring narrow stile device. Mounting screws shall be concealed to deter tampering. All ferrous parts shall be zinc coated to prevent rusting.

C. Single point, one quarter turn hex dogging shall be standard on panic listed devices. Optional key cylinder dogging shall be available, and furnished if so indicated in the hardware sets, on panic listed devices. Devices with hex key dogging shall be easily field converted to cylinder dogging.

D. All devices shall be listed by Underwriters Laboratories for safety as panic hardware. Fire rated devices shall be UL listed for A label and lesser class doors, 4’ x 8’ single and 8 x 8’ pair. The model number shall be located on the end cap; devices having the model number located other than on the end cap shall not be acceptable.

E. All exit devices shall have a unitized installation feature and may be cut in the field to size. Devices shall be closed on all sides with no pinch points. The pushpad shall be designed to prevent pinching of the fingers when depressed.

F. Exit Device trim to be throughbolted. Lever trim to be heavy duty forged escutcheon with free wheeling levers.

G. All exit devices shall conform to Federal Specification FF-H-1820, and be certified as meeting ANSI A156.3, Grade 1 requirements.

2.06 CYLINDERS

A. Manufacturers:
   1. Scheduled Manufacturer: Best
   2. Acceptable Manufacturers: No Substitution

B. Requirements:
   1. Provide permanent cylinders/cores to match Owner’s existing key system, compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer’s series as indicated. Refer to “KEYING” article, herein.
   2. Replaceable Construction Cores.
      a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
         1) 3 construction control keys
         2) 12 construction change (day) keys.
      b. Owner or Owner’s Representative will replace temporary construction cores with permanent cores.
2.07 KEYING

A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Provide cylinders/cores keyed into Owner’s existing factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

C. Requirements:
   1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      a. Master Keying system as directed by the Owner.
   2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   3. Provide keys with the following features:
      a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
      b. Patent Protection: Keys and blanks protected by one or more utility patent(s).

D. Identification:
   1. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication “Keying Systems and Nomenclature” for identification. Blind code marks shall not include actual key cuts.
   2. Identification stamping provisions must be approved by the Architect and Owner.
   3. Stamp cylinders/cores and keys with Owner’s unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with “DO NOT DUPLICATE” along with the “PATENTED” or patent number to enforce the patent protection.
   4. Failure to comply with stamping requirements shall be cause for replacement of keys involved at no additional cost to Owner.
   5. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

E. Quantity: Furnish in the following quantities.
   1. Change (Day) Keys: 3 per cylinder/core.

2.08 KEY CONTROL

A. Manufacturers:
   1. Scheduled Manufacturer: Telkee
   2. Acceptable Manufacturers: HPC, Lund

B. Requirements:
   1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
      a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
      b. Provide hinged-panel type cabinet for wall mounting.

2.09 LOW PROFILE PUSH BAR EXIT DEVICES

A. The maximum exit device projection shall be a maximum of 3-1/16” when activated. The exit device bar shall have an average minimum thickness of .201”. The pushpad surface shall
be constructed of stainless steel; pushpads with plastic or Lexan coatings shall not be acceptable. Nylon bearings and stainless steel springs shall be used for long life and durability. Only torsion or compression springs are acceptable. Extension type springs are not acceptable. All device covers shall be of cast brass, deep drawn steel or stainless steel. Latchbolts shall be of stainless steel and shall have a deadlocking latch for extra security, except at full-glass or two-light glass doors requiring narrow stile device. Mounting screws shall be concealed to deter tampering. All ferrous parts shall be zinc coated to prevent rusting.

B. Single point, one quarter turn hex dogging shall be standard on panic listed devices. Optional key cylinder dogging shall be available, and furnished if so indicated in the hardware sets, on panic listed devices. Devices with hex key dogging shall be easily field converted to cylinder dogging.

C. All devices shall be listed by Underwriters Laboratories for safety as panic hardware. Fire rated devices shall be UL listed for A label and lesser class doors, 4' x 8' single and 8' x 8' pair. The model number shall be located on the end cap; devices having the model number located other than on the end cap shall not be acceptable.

D. All exit devices shall have a unitized installation feature and may be cut in the field to size. Devices shall be closed on all sides with no pinch points. The pushpad shall be designed to prevent pinching of the fingers when depressed.

E. Exit Device trim to be throughbolted. Lever trim to be heavy duty forged escutcheon with free wheeling levers.

F. All exit devices shall conform to Federal Specification FF-H-1820, and be certified as meeting ANSI A156.3, Grade 1 requirements.

G. Acceptable Manufacturers: Von Duprin or Substitution requests allowed up to time of bid

2.10 DOOR CLOSERS

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: LCN

B. Requirements:
   1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory.
   2. Provide door closers with fully hydraulic, full rack and pinion action cast iron cylinder.
   3. Closer Body: 1-1/4 inch (32 mm) diameter, with 5/8 inch (16 mm) diameter heat-treated pinion journal.
   4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
   5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Cylinder body to have “FAST” power adjust speed dial to visually indicate spring power.
   6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
   7. Pressure Relief Valve (PRV) Technology: not permitted.
   8. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.11 DOOR TRIM

A. Manufacturers:
   1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Trimco

B. Requirements:
1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.12 PROTECTION PLATES
A. Manufacturers:
1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Trimco
B. Requirements:
1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, bevelled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
   a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
   b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
   c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.13 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS
A. Manufacturers:
1. Scheduled Manufacturers: Glynn-Johnson
B. Requirements:
1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.
2.14 DOOR STOPS AND HOLDERS
   A. Manufacturers:
      1. Scheduled Manufacturer: Ives
      2. Acceptable Manufacturers: Burns, Trimco
   B. Provide door stops at each door leaf:
      1. Provide wall stops wherever possible. Provide convex type where mortise type locks are
         used and concave type where cylindrical type locks are used.
      2. Where a wall stop cannot be used, provide universal floor stops for low or high rise
         options.
      3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead
         stop.

2.15 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND
      GASKETING
   A. Manufacturers:
      1. Scheduled Manufacturer: Zero International
      2. Acceptable Manufacturers: National Guard, Reese
   B. Requirements:
      1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and
         gasketing systems (including smoke, sound, and light) as specified and per architectural
         details. Match finish of other items.
      2. Size of thresholds:
         a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
         b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door
            width
      3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient
         or flexible seal strip is easily replaceable and readily available.

2.16 SILENCERS
   A. Manufacturers:
      1. Scheduled Manufacturer: Ives
      2. Acceptable Manufacturers: Burns, Trimco
   B. Requirements:
      1. Provide "push-in" type silencers for hollow metal or wood frames.
      2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for
         each pair frame.
      3. Omit where gasketing is specified.

2.17 FINISHES
   A. Finish: BHMA 613/640 (US10B); except:
      1. Hinges at Exterior Doors: BHMA 640 (US10B)
      2. Continuous Hinges: BHMA SP313 (US10B)
      3. Push Plates, Pulls, and Push Bars: BHMA 613 (US10B)
      4. Protection Plates: BHMA 613 (US10B)
      5. Overhead Stops and Holders: BHMA 613 (US10B)
      6. Door Closers: Powder Coat to Match
      7. Wall Stops: BHMA 613 (US10B)
      8. Weatherstripping: Dark Bronze
      9. Thresholds: Dark Bronze
PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

3.02 PREPARATION

A. Before hardware installation is begun, hardware supplier shall brief installers on proper hardware installation so that items are installed in accordance with manufacturer's installation instructions. Hardware supplier shall inspect all work for proper hardware operations and shall give written maintenance and operation instructions to the Owner. Construction cores installed by Contractor shall be used during construction.

B. Where on-site modification of doors and frames is required:
   1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
   2. Field modify and prepare existing door and frame for new hardware being installed.
   3. When modifications are exposed to view, use concealed fasteners, when possible.
   4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
      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: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
      c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
   2. Custom Steel Doors and Frames: HMMA 831.

B. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity 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.

H. 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).

I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
   1. Replace construction cores with permanent cores as indicated in keying section.

J. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Levers and roses to be lead lined. Apply kick and armor plates on lead-lined doors with adhesive as recommended by manufacturer.

K. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
   1. Conduit, junction boxes and wire pulls.
   2. Connections to and from power supplies to electrified hardware.
   3. Connections to fire/smoke alarm system and smoke evacuation system.
   4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
   5. Testing and labeling wires with Architect’s opening number.

L. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

M. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.

N. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
   1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

T. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 OCCUPANCY AND SITE SECURITY TRANSFER

A. Contractor is responsible to schedule and directly pay for change in cores, and keys delivered to Owner, direct by factory installation.
B. The Contractor shall notify key system distributor / installer three months before the scheduled completion date of the project to ensure distributor sufficient time to remove the construction cores and replace them with the final cores within one week of accepting occupancy of each unit or building. Contractor shall notify Owner at least 1 month prior to change in responsibility for security, for each building and/or area to be occupied by Owner.

1. Once the final lock cores have been replaced, Owner assumes primary responsibility for security of the building and its contents, or portions thereof that are occupied by Owner.

2. It shall be the responsibility of Owner’s staff to unlock the buildings, or to make other arrangements, to allow any representative of the General Contractor or authorized subcontractor to enter the building for completion of all work remaining to be accomplished after the building or portion thereof has been occupied by Owner.

3. The facilities are secure facilities requiring protocols to protect the safety and security of personnel, property, and evidence. Contractor shall make every effort to avoid or minimize disruption to Owner’s operations after occupancy, and shall comply with Owner’s security provisions for access to restricted or secure areas after Owner occupancy.

3.05 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.06 ADJUSTING AND PROTECTION

A. Test all doors and hardware for proper operation.

B. Adjust all hardware in compliance with ADA / TAS and reference standards, and in compliance with corrections required as noted in hardware supplier’s field inspection report.

C. Just prior to requesting inspection for substantial completion, test all doors and hardware again to ensure readiness for Architect’s inspection, in compliance with these specifications, and according to the Architect’s habitual punch list items as noted in Division 01, 01 77 00A “Substantial Completion Readiness Checklist”.

1. Make corrections to the extent feasible prior to Architect’s inspection.

2. Where corrections have not been made prior to inspection, record a list of deficiencies and include in Construction Manager’s Punch List, to be submitted to Architect prior to Architect’s inspection.

D. Protect all finish hardware from scratching or other damage.

3.07 HARDWARE SETS

A. Hardware Set Numbers and Doors are cross referenced Below:
<table>
<thead>
<tr>
<th>Door Schedule Number</th>
<th>Hardware Set Number</th>
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<tbody>
<tr>
<td>100A</td>
<td>815AL</td>
</tr>
<tr>
<td>104</td>
<td>811AC</td>
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## DEVIL’S RIVER SNA, DAN A. HUGHES UNIT HARDWARE SETS

### Hardware Group No. 011

For use on Door #(#s):

104A  
104B  

Provide each SL door(s) with the following:

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<td>NOTE</td>
<td>HARDWARE BY DOOR</td>
<td>UNK</td>
<td>MANUFACTURER</td>
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</table>

### Hardware Group No. 103A

For use on Door #(#s):

107  
108  
112  

Provide each SGL door(s) with the following:

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<td>1</td>
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<td>613</td>
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<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>613</td>
<td>IVE</td>
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<td>SEAL</td>
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### Hardware Group No. 201

For use on Door #(#s):

116  

Provide each SGL door(s) with the following:

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<td>LCN</td>
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<td>IVE</td>
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TPWD #118540 - DEVIL’S RIVER SNA DAN A. HUGHES UNIT  
APRIL 16, 2021  
DOOR HARDWARE
### Hardware Group No. 205

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<td>SCUSH X MTNG BRCK,</td>
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<td>SURFACE CLOSER 4050A</td>
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<td>SFIC KEYED AS DIRECTED</td>
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**Hardware Group No. 403**

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<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
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**Hardware Group No. 501**

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Hardware Group No. 725A

For use on Door #(s):
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Provide each SGL door(s) with the following:

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Hardware Group No. 811AC

For use on Door #(s):
104

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Hardware Group No. 815AL

For use on Door # (s):

100A 104C

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END OF SECTION 08 71 00
SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY
A. Section Includes:
   1. Provide all glass and glazing as shown on the drawings and as herein specified.
B. Related Sections include the following:
   1. Division 5 Section “Metal Fabrications.”
   2. Division 8, All “Door” and “Window” Sections.
   3. Division 8 Section “Aluminum Folding Doors, Storefront and Window.”
   4. Division 8 Section “Metal Windows.”
   5. Division 8 Section “Manual Sliding Aluminum Storefront Door.”

1.03 DEFINITIONS
A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
C. Interspace: Space between lites of any insulating glass unit that contains dehydrated air or a specified gas.
D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer’s written instructions. Defects include peeling, cracking and other indications of deterioration in metallic coating.
E. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer’s written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer’s written instructions. Defects include edge separation, delamination material obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standards.

1.04 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings:
1. Review storefront and window shop drawings and submit acceptance of details as suitable for proposed glass products.

C. Submit 12-inch square samples of each type of glass indicated except for clear monolithic glass products, and 12-inch long samples of each color required (except black) for each type of sealant or gasket exposed to view.

1.05 INFORMATIONAL SUBMITTALS:

A. Qualification Data.

B. Product Certificates: Certificate of Compliance for all glass products.
   1. Insulating Glass Certification: Submit data verifying compliance with IGCC, Class A level.

C. Compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants and other glazing materials.
   1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Wind Pressure and Thermal Stress Analysis: Submit thermal stress analysis of glass where thermal stress may occur.

E. Sample Warranties: For special warranties.

1.06 DESIGN REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Provide glass lites in the thickness and strengths (annealed or heat-treated) to meet or exceed the following criteria based on analysis of Project loads and in-service conditions.

   1. Minimum glass thickness of lites composed of annealed or heat-treated glass are selected so the worst-case probability of failure does not exceed the following:
      a. Eight (8) lites per 1000 for lites set vertically or not over 15 degrees off vertical and under wind action.
      b. One (1) lite per 1000 for lites set over 15 degrees off vertical and under action of wind or snow.
      c. Specified Design Wind Loads: As indicated on the Structural Drawings.
      e. Minimum Glass Thickness for Exterior Lites: Not less than 6mm
      f. Thickness of Tinted and Heat-Absorbing glass: Provide the same thickness of each tint color indicated throughout Project.

   2. Maximum Lateral Deflection: For the following types of glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.
      a. For insulating glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer’s published test data, as determined according to procedures indicated below:
1. Center-of-glass U-values: NFRC 100 methodology using LBL-35298 WINDOW 5.2 computer program, expressed as BTU/sq ft x h x deg F (W/sq. m x K).
2. Center-of-glass solar heat gain coefficient: NFRC 200 methodology using LBL-35298 WINDOW 5.2 computer program

1.07 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
      a. Glass fabricator to have 10 years of experience and meet ANSI / ASQC Q9002 1994.
   2. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certified Glass Installer Program.
   3. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

B. Coordination: Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Energy Code Compliance: Coordinate all exterior glazing with applicable framing systems to assure compliance with current applicable energy codes before product submittals. If revisions to specified products are required coordinate revised products with the architect and owner.

D. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the inspecting and testing agency, Insulating Glass Certification Council.

E. Installation Criteria: FGJA “Glazing Manual”, in addition to any other referenced standards.

F. Single Source fabrication responsibility: Fabrication processes, including Low E and reflective coatings, insulating, laminating, silkscreen, and tempering, shall be fabricated by a single Fabricator.

G. Safety Glazing: Applicable standards
   2. ANSI Z97.1, Safety Glazing Materials Used in Buildings
   3. ASTM C1036, Flat Glass
   4. ASTM C1172, Laminated Architectural Flat Glass
   5. ASTM C1048, Heat-Treated Flat Glass

H. Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section or in referenced standards.
   1. GANA Publications
      a. GANA Glazing Manual
      b. GANA Laminated Glazing Reference Manual
      c. GANA Tempering Division - Engineering Standards Manual
5. LSGA Publications.

I. Flat Glass
   1. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
      a. Kind HS heat-treated glass
      a. Kind fully tempered (FT)

J. Safety glass products are to comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.
   1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

K. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
   1. ASTM E773 Seal Durability of Sealed Insulating Glass Units
   2. ASTM E774 Sealed Insulating Glass Units
   3. Sealed insulating glass units to be double sealed with a primary seal of black (or gray) polysisobutylene and a secondary seal of black (or gray) silicone.
   4. Lites shall be separated by an aluminum spacer with 3 bent corners and 1 keyed- soldered corner, or 4 bent corners and a straight butyl injected zinc plated steel straight key joint, to provide a hermetically sealed and dehydrated air space.
   5. Units shall be certified for compliance with seal classification "CBA" by the Insulating Glass Certification Council (IGCC) and tested in accordance with the above ASTM Test Methods.

L. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites.
   2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg.
   4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBNL WINDOW 6 computer program.
   5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

M. Mockups: Before glazing, build mockups for each glass product indicated below to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups using materials indicated for the completed work.
   1. Build mockups in combination with storefront mockup requirements.
   2. Build mockups with the glass to match glazing systems required for Project, including typical lite size, framing systems, and glazing methods:
   3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING
A. Protect glazing materials according to manufacturer’s written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun or other causes.

1.09 PROJECT CONDITIONS
A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by the glazing material manufacturers and when glazing channel substrates are wet from rain, frost condensation, or other causes.
   1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C)

1.10 WARRANTY
A. Insulating Glass, Warranty sealed insulating glass units for minimum period of ten (10) years, with manufacturer's replacement guarantee, covering as minimum: Defective or failure of seal; material vision obstruction as result of dust collection or film formation between panels or other similar failure and the following specific conditions:
B. Tempered Glass: Provide a written 10-year warranty from date of Substantial Completion for tempered glass.
   1. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.
C. Coated Glass: Provide a written 10-year warranty from date of Substantial Completion for coated glass.
D. Warranties shall cover deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to the glass manufacturer's published instructions.
E. Glazing installer shall coordinate glass and glazing installation with framing systems and install glass and glazing in accordance with manufacturer's instructions, so that warranty is maintained.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Basis of Design Products: Basis of Design products are indicated in the Glass Schedule later in this section. Provide Basis of Design products, or equal products as approved by Architect.
B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
C. Fabricators for Specialty Glass and Specialty Glass Units: As specified with individual glass type descriptions or approved equal by another Manufacturer.
2.02 GLASS PRODUCTS

A. Flat Glass
   1. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
      a. Kind HS heat-treated glass
   3. Fully tempered float glass: ASTM C 1048
      a. Kind fully tempered (FT)

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
   1. Sealed insulating glass units to be double sealed with a primary seal of black (or gray) polyisobutylene and a secondary seal of black (or gray) silicone.
   2. Lites shall be separated by an aluminum spacer with 3 bent corners and 1 keyed- soldered corner, or 4 bent corners and a straight butyl injected zinc plated steel straight key joint, to provide a hermetically sealed and dehydrated air space.
   3. Units shall be certified for compliance with seal classification "CBA" by the Insulating Glass Certification Council (IGCC) and tested in accordance with the above ASTM Test Methods.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites.
   2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
   4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBNL WINDOW 6 computer program.
   5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.03 GLASS AND GLAZING UNIT MATERIALS

A. Provide safety glazing at all impact locations, per applicable building codes.

B. Substitutions: Architect will consider glass substitutions of comparable products by other manufacturers for exterior glazing only if all exterior glass (both in storefront and factory glazed aluminum clad wood windows) is substituted to be produced by the same manufacturer, in order to ensure quality and color match.

C. Glass Types:
   1. Type 1: 1/4" Clear float, (at interior storefront system).
   2. Type 2: 1/4" Clear float, tempered (at interior storefront system).
   3. Type 3: 1" Insulated, tempered; Guardian SunGuard "SNX 62/27" on Crystalgray (Low-E)
      a. Visible Light Transmittance: 45%.
      b. Winter Nighttime U – Value: .29
      c. Solar Heat Gain Coefficient: .22
   4. Type 4: 1" Insulated; Guardian SunGuard "SNX 62/27" on Crystalgray (Low-E)
      a. Visible Light Transmittance: 45%.
      b. Winter Nighttime U – Value: .29
      c. Solar Heat Gain Coefficient: .22
5. Type 5: Spandrel Glass: Glass to match glass type #3 above, but with back-painted or ceramic frit on 4th surface.
6. Type 11: Mirror, continuous stainless-steel frame: 1/4” thickness

2.04 MISCELLANEOUS GLAZING MATERIALS

A. General: Select glazing sealants, tapes, gaskets and other glazing materials of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer, or as specified in other Sections.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.05 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

2. Temperature Change: 180 deg F, material surfaces.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Carefully inspect and verify all job site conditions and measurements. Field verify all existing conditions and dimensions which receive glazing.

B. Clean all surfaces of all glazing units and materials to which glazing compound and/or tapes shall be applied and prime as recommended by compound and/or tape manufacturer's instructions.

C. Verify prepared openings for glazing are correctly sized and within tolerance.

D. Verify that a functioning weep system is present.

E. Verify that the minimum required face and edge clearances are being followed.

F. Do not proceed with glazing until unsatisfactory conditions have been corrected.

G. Clean glazing channels and other framing members receiving glass immediately before glazing remove coatings not firmly bonded to substrates.

H. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
3.02 GLAZING INSTALLATION

A. General:
   1. Comply with glass fabricator’s recommendations.
   2. Install in accordance with glass and frame manufacturer's instructions.
   3. Install plumb, level, square, true to line, and without warp or rack. Provide all fasteners required for installation.
   5. Material installed in a full bed of sealant, tooling finished surfaces smooth.
   6. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
   7. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
   8. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

B. Glazing to fit line in rabbet with all edges straight and true. Size substantially as shown on the drawings, however Contractor shall fill sash and openings as actually constructed whether more or less than sizes given.

C. Do not apply glazing materials at temperatures below manufacturer's recommendations or to damp or frosted surfaces. Apply glazing material according to the manufacturer's instructions using proper primers as required.

D. Set glass using neoprene setting blocks and spacers to insure proper edge clearance and uniform beads of compound. Clearances shall conform to FGMA Glazing Manual requirements. Center glass in glazing rabbets.
   1. Butt glazing requirements: Apply mildew resistant silicone sealant to flush depth of joint as indicated by sealant manufacturer.

E. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

F. Check openings to confirm proper clearance at perimeters and between glass and stops.
   1. Clean surfaces of rabbet (including stops) and surface of glass which will come into contact with sealant. Use solvents and methods which insure clean, dry surfaces without film or foreign material when sealant is placed.

G. Remove and replace glazing beads carefully to avoid marking or defacing any portion of frame, sash, or fastenings.
   1. Set glass in full bed of glazing tape or sealant. Clean glazing material after stops are installed. Clean excess compound, etc. from glass after setting in conformance with glass manufacturer's recommendations.
   2. If recommended prime surfaces prior to glazing.

H. Set glass with reams (waves) running horizontally. Set glass with factory attached labels in place.

I. Setting Blocks: Place setting blocks at locations recommended by glass manufacturer, generally between 1/4 points and 6 inches from corner, except at glazed doors.
   1. At glazed doors, provide one block at sill, located 3 inches up from edge of glass at hinge side; one block at hinge side jamb, located 3 inches up from lower edge of glass; one block at head, located 3 inches from edge of glass at latch side of door; and, one block at jamb at lock side of door, located 3 inches down from edge of glass at top corner.
   2. Use blocks of length required to properly support glass. Offset approximately 1 inch from shims.
J. Glass Installation in Aluminum Frames:
   1. Glaze aluminum frames using preformed EPDM elastomeric glazing extrusion separately
      or in combination with sealant and pre-shimmed glazing tape in compliance with
      aluminum frame supplier's recommendations.
   2. Set glass on setting blocks as recommended by manufacturer.
   3. Apply tape and/or sealant to produce uniform sight line even with frame.
   4. Set glass in gaskets with corners sealed.

K. Glazing Sealant: Along entire bottom edge of light, and up at least 6 inches at each jamb,
   gun in continuous full bed of sealant to fill voids.
   1. Fill entire space, full width of pane, full depth of glass, with sufficient sealant to form
      heel along inside face and edge of glass.
   2. At other edges (top and sides) gun in continuous heel bead of sealant along edges of glass
      perimeter to set stop against and into, acting as fill between glass and stop.
   3. Immediately after setting glass, at entire perimeter of glass, gun in sealant between stop
      and glass so space above spacer is completely filled, without voids.
   4. Place sealant flush with daylight edge of stops, with slight watershed at exterior. Provide
      straight, smooth surface meeting at opening corners with sharp intersection.
   5. Leave no sealant on exposed surfaces of stops and glass.

3.03 ADJUSTING AND CLEANING

A. Immediately after installation remove nonpermanent labels and clean surfaces.
   1. Clean excess sealant or compound from glass and framing members immediately after
      application, using solvents or cleaners recommended by manufacturers.

B. Glazing shall be protected from damage, and from contact with contaminating or harmful
   substances, during construction. Examine glass surfaces adjacent to or below exterior
   concrete and other masonry surfaces at frequent intervals during construction, but not less
   than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
   1. If, despite protection measures, contaminating substances do come into contact with
      glass, remove substances immediately as recommended in writing by glass manufacturer.
      Remove and replace glass that cannot be cleaned without damage to coatings.
   2. Contractor shall assume all responsibility for breakage and shall replace cracked, broken,
      scratched or otherwise defective glazing.

C. Glazing shall be carefully cleaned at time of final acceptance, removing all non-permanent
   labels, excess sealant, paint and other foreign substances. Wash glass as recommended in
   writing by glass manufacturer.

END OF SECTION 08 80 00
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Extent of louvers is indicated on drawing, including sizes and locations. Coordinate the size and locations with mechanical drawings and specifications. Provide complete attachments to substrates indicated.

B. Related Sections include the following:
   1. Division 04 Section - "Unit Masonry Assemblies".
   2. Division 05 Section - "Metal Fabrications", for masonry loose lintels and miscellaneous steel for louver attachment.
   3. Division 06 Section - "Rough Carpentry".
   4. Division 07 Section - "Fluid Applied Weather Barrier".
   5. Division 07 Section - "Joint Sealants".
   6. Division 07 Section - "Sheet Metal Flashing and Trim".
   7. Division 23 Mechanical, for ducts, dampers, and other adjacent construction.

1.03 QUALITY ASSURANCE

A. Performance Requirements: Where louvers are indicated to comply with specific performance requirements, provide units whose performance ratings have been determined in compliance with Air Movement and Control Association (AMCA) Standard 500.

B. Comply with SMACNA "Architectural Sheet Metal Manual" recommendation for fabrication, construction details and installation procedures, except as otherwise indicated.

C. Field Measurements: Verify size, location and placement of louver units prior to fabrication, wherever possible.

D. Coordination with Wall Openings: Verify final louver size includes required free area for model specified before creating rough opening in exterior material.

E. Shop Assembly: Coordinate field measurements and shop drawings with fabrication and shop assembly to minimize field adjustments, splicing, mechanical joints and field assembly of units. Pre-assemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordination.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for required products, including finishes.

B. Shop Drawings: Submit shop drawings for fabrication and erection of louver units and accessories. Include plans, elevations and details of sections and connections to adjoining work. Indicate materials, finishes, fasteners, joinery and other information to determine
compliance with specified requirements. Submit complete line of premium and standard color samples (12 colors minimum) for selection by Architect.

1.05 WARRANTY
A. Louver: Provide 5-Year Warranty on Louver.

PART 2 - PRODUCTS

2.01 MATERIALS
A. Horizontal Blade Aluminum Louvers:
   1. Typical louver, unless noted otherwise: Stationary 4" deep frame, 45 degree blade angle and approximately 4" vertical spacing, equal to Ruskin ELF445DX, minimum 50% free area. Thickness not less than 0.081" for frames and extruded aluminum blades (Alloy 6063-T5). Provide bird screen and metal mesh insect screen.
   2. Louvers under 1 SF in size: Stationary 2" deep frame, 45 degree blade angle and 2-7/16" vertical spacing, equal to Ruskin ELF211D, nominal 38% free area. Thickness not less than 0.060" for frames and extruded aluminum blades (Alloy 6063-T5). Primer shall be thermo-cured, 0.2 mil d.f.t. Finish shall be factory applied, high performance, fluorocarbon coating. Provide bird screen and metal mesh insect screen.
   3. Size louvers to sizes noted in Drawings, or to required open areas noted in Mechanical drawings and specifications, whichever is greater.
   4. Sill Flashing: Provide integral sill flashing or matching extended sill pan flashing that provides a 1-1/2" to 2" vertical turn down with drip edge at the exterior wall finish.
   5. Aluminum Louver Finish:
      a. Kynar Coated; color to be selected by Architect
B. Louver Screens: Provide frames consisting of U-shaped metal for permanently securing metal insect screen and bird screen mesh. Locate screens on inside face of louvers. Secure screens to louver frames with machine screws, spaced at each corner and at 12" o.c. between.
C. Fastenings: Fasteners for exterior applications may be hot-dip galvanized, stainless steel or aluminum.
D. Anchors and Inserts: Use non-ferrous metal or hot-dip galvanized anchors and inserts. Furnish inserts, as required, to be set into concrete or masonry work.

2.02 FABRICATION
A. Provide louvers and accessories of design, materials, sizes, depth, arrangement, and metal thicknesses indicated, or if not indicated, as required for optimum performance with respect to airflow; water penetration; air leakage, where applicable (for adjustable units, if any); strength; durability; and uniform appearance.
B. Fabricate frames including integral sills to suit adjacent construction with tolerances for installation including application of sealants in joints between louvers and adjoining work.
C. Include supports, anchorage, and accessories required for complete assembly.
D. Provide vertical mullions of type and at spacing recommended by manufacturer or 72" o.c., whichever is less. No intermediate.
E. Join Frame members to one another and to stationary louver blades by spline screwed, except where indicated otherwise or where field bolted connections between frame members are made necessary by size of louvers. Maintain equal blade spacing including separation between blades and frames at head and sill to produce uniform appearance.
PART 3 - EXECUTION

3.01 PREPARATION
A. Coordinate setting drawings, diagrams, templates, instructions and directions for installation of anchorage which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.02 INSTALLATION
A. Locate and place louver units plumb, level and in proper alignment with adjacent work.
B. Use concealed anchorage wherever possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers, as indicated.
D. Repair finishes damaged by cutting, welding, soldering and grinding operations require for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to shop, make required alterations, and refinish entire unit, or provide new units, at Contractor's option.

END OF SECTION 08 90 00
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. This Section includes the following:
   1. Interior gypsum board.
   2. Tile backing panels.
   3. Plenum return air spaces (ASTM E84 or UL 723)

B. Related Sections include the following:
   1. Division 6 Section "Rough Carpentry."
   2. Division 6 Section “Interior Architectural Woodwork”, for coordination of framed cabinet supports.
   3. Division 7 Section "Thermal Insulation."
   4. Division 7 for additional requirements for fire stopping and sealants installed with gypsum board assemblies.
   5. Division 9 Sections "Painting."
   6. Division 9 Sections, for coordination of tiling, wall-based materials, and other finishes applied to gypsum board assemblies.
   7. Divisions 10 and 11, and other Sections as applicable, for coordination of accessories and equipment requiring blocking in walls.

1.03 QUALITY ASSURANCE


B. Tolerances: 1/8" Offsets between planes of board faces and 1/4" in 8'-0" for plumb, level, warp and bow.
1.04 PERFORMANCE / DESIGN CRITERIA

A. Deflection Limits:
   1. Limit deflection of partitions to following limits, based on design load.
      a. Partitions to receive tile, plaster, adhered stone, or similar heavy finish materials: L/240.
      b. Other partitions: L/120.
      c. Comply with minimum stud gauges required elsewhere in these specifications, the most stringent requirement shall prevail. If partition height exceeds stud manufacturer's limiting height for applicable loading and deflection, install bracing above ceiling, decrease stud spacing, or increase stud gauge.
   2. Limit deflection of ceilings to L/360.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials with manufacturer's label attached. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging. Protect materials from dampness or wetting. Remove any damaged materials.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, 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, those that are moisture damaged, and those that are 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.

1.07 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Certificate: Furnish certificate evidencing that material meets or exceeds specification and fire rating requirement.
C. Samples: For the following products:
   1. Textured Finishes: Provide mockup of texture finish for all walls.

PART 2 - PRODUCTS

2.01 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. Materials on project must be supplied by one manufacturer throughout.

2.02 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. USG Corporation.

B. Moisture and Mold Resistant: With moisture and mold resistant core and paper surfaces, mold resistance ASTM D 3273, score of 10 as rated according to ASTM D 3274.
   1. Thickness: 5/8”.
   2. Long Edges: Tapered.
   3. Location: At restrooms, janitor’s closet, break room, and similar wet and washable locations, except for backer board installed behind tile.

C. Type X Gypsum Board:
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.
   3. Location: Typical where other wallboard type is not otherwise indicated.

D. Type C:
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.
   3. Location: Fire rated ceilings.

2.03 TILE BACKING PANELS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325.
   1. Products: Subject to compliance with requirements, provide one of the following or other approved equal:
a. Custom Building Products; Wonderboard.
b. United States Gypsum Co.; Durock Cement Board.
2. Thickness: As indicated.

2.04 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized steel sheet or rolled zinc.
   2. Shapes:
      b. Metal Edge Trim: Standard trim of galvanized steel with either knurled and perforated or expanded flanges and beaded for concealment of flange in joint compound. Equal to USG 200 or 400 Series. Apply where board abuts or terminates at another material.
         1) L-Bead: L-shaped; exposed long flange receives joint compound; use at exposed panel edges.
         2) J-Mold: Metal J-molds; exposed flange receives joint compound, use at all panel edges abutting dissimilar materials.
      c. Gypsum Control Joints: Metal V-shape control joints. Use where indicated and at changes in backup material and in partitions at 30'-0” o.c. maximum, and at large gypsum board ceiling areas at 20'-0” o.c. maximum. Also provide at both sides all interior and exterior window & door frames.

2.05 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
   3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: 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, equal to USG Durabond 90.
   2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound, equal to USG Durabond Joint Taping Compound.
   3. Fill Coat: For second coat, use drying-type, all-purpose compound, equal to USG Ready Mixed Joint Topping.
   4. Finish Coat: For third coat, use drying-type, all-purpose compound.
   5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:
   1. Cementitious Backer Units: As recommended by backer unit manufacturer.
2.06 **AUXILIARY MATERIALS**

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Door frame Grout: Equal to USG Durabond 90 Joint Compound, Multi-Purpose.

C. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
   1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Insulation:
   1. Thermal Insulation: Refer to Division 07, Section "Thermal Insulation".
   2. Acoustical Insulation: Refer to Division 09, Section "Acoustical Insulation".
   3. Fire Resistant Assemblies: Provide mineral fiber insulation according to the requirements of the fire rated assembly, except where greater thickness is indicated for partitions that also carry an acoustical rating.

2.07 **TEXTURE FINISHES**

A. Primer: As recommended by textured finish manufacturer.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. G-P Gypsum; Georgia-Pacific Toughrock Regency Ceilings/Polystyrene.
      b. National Gypsum Company; Perfect Spray.
      c. USG Corporation; SHEETROCK Ceiling Spray Texture, QT.
   2. Texture: Light Orange Peel.

PART 3 - EXECUTION

3.01 **EXAMINATION AND COORDINATION**

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Interface and Coordination with Other Work:
   1. Coordinate installation of firestopping at penetrations through fire-resistive rated assemblies.
   2. Coordinate installation of joint sealers specified in Division 7 Section at penetrations of non fire-resistive rated assemblies.
   3. Coordinate support framing and blocking requirements of all construction to be attached to gypsum board assemblies.
4. At partitions indicated to receive thermal or acoustical batts, pack insulation into cavities while framing is being fabricated for stud packs, box headers, and other framing cavities that will be inaccessible upon erection of framing.

5. Coordinate installation with joints in adjacent construction designed to reduce transmission of sound. Do not install gypsum board assemblies in a manner to create an acoustical bridge across such joints and conditions. Conditions include but are not limited to the following:
   a. Floor and slab acoustical isolation and similar construction details.
   b. Acoustical isolation of structural members and components.
   c. Mechanical ductwork acoustical joints and construction.

D. Fire rated wall partitions installed to provide specified design criteria requirements. Partitions continuous from floor level to underside of structure and completely fire taped.

3.02 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 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 shall be accomplished with scraps of not less than 8 sq. ft. 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 wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch wide spaces at these locations, and
trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

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. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

J. Joint Treatment Application:
   1. Joint treatment compounds and products, as specified under Materials, shall be mixed and applied in accordance with manufacturer's direction to completely conceal all joints and screw depressions and provide a smooth surface to receive finishes as scheduled.

3.03 FINISH

A. Apply gypsum board finish in accordance with manufacturer's published instructions and GA-214 Finish Levels.
   1. Level 4: All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. All joint compound shall be smooth and free of tool marks and ridges.
   2. Prepared surface shall be coated with a primer/sealer prior to the application of finish paint. Refer to specification Division 09: Section "Painting".
      a. Application: For use where gloss semi-gloss, enamel, or nontextured flat paints are specified or where severe lighting conditions occur. Generally in all areas except where noted otherwise.
   3. Fit gypsum panels around ducts, pipes, conduits, and structural members. Cut panels to fit profile of penetrations and apply a bead of sealant 1/4" to 3/8" wide.
   4. Rated partitions shall have wall board continuous both sides above ceiling to deck and fire taped and sealed.

3.04 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Type X: As indicated on Drawings.
   2. Moisture- and Mold-Resistant Type: As indicated on Drawings in all wet areas.
   3. Partitions indicated sealed to deck shall be continuous except where interrupted by structure, mechanical or electrical construction.

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 horizontally, 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 high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

3.05 APPLYING TILE BACKING PANELS

A. Cementitious Backer Units: Install behind tile at restrooms and where indicated on drawings, according to ANSI A108.11.
B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
C. Seal ends, cut edges and penetrations of each piece with water resistant compound before installation.
D. Tape & mortar over all joints prior to tile installation and as required to receive tile waterproofing system.

3.06 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.
   1. Control Joints: Install where detailed, at changes in backup material and in partitions 30'-0" O.C. unless otherwise noted.
B. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners, unless otherwise indicated.
   2. LC-Bead: Use at exposed panel edges; install on external corners with suitable fasteners spaced 9" O.C.
   3. L-Bead: Use where indicated; install on external corners with suitable fasteners spaced 9" O.C.
   4. U-Bead: Use at exposed panel edges where indicated; install on external corners with suitable fasteners spaced 9" O.C.
   5. Metal Trim: Install over face layer with fasteners spaced 9" O.C. where shown and where gypsum surfaces meet dissimilar materials.
   6. Reveal Molding: Use where indicated; install with suitable fasteners spaced 9” on center.

3.07 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 and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

E. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
   1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
   2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
   3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply spray applied level 4 finish, typical, where panels are to receive paint, typical.
      a. At panel surfaces that will be exposed to view.
      b. Primer and its application to surfaces are specified in other Division 09 Sections.
   4. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply spray applied level 5 finish equal to rapid deco level 5 by Lafarge (per ASTM C 840 level 5) over entire surface, typical, at corridors where panels are to receive paint.

3.08 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 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 recommendations.

3.09 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   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.

3.10 CONSTRUCTION

A. Interface with Other Work:
   1. Coordinate installation of firestopping at penetrations through fire-resistive rated gypsum board partitions.
   2. Coordinate installation of joint sealers specified in Division 7: Section Sealants at penetrations of non fire-restive rated partitions.

3.11 PATCHING

A. Contractor shall repair and patch around penetrations in walls where piping, ductwork, conduit, cables, etc. are required.

3.12 CLEANING

A. Contractor shall completely clean all areas affected by this work and shall leave no excess or scrap materials or bedding compound on the job site.

END OF SECTION 09 29 00
SECTION 09 30 13 - CERAMIC TILING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. This Section includes the following:
   1. Ceramic tile.
   2. Crack suppression membrane for thin-set and medium set tile installations.
   3. Cementitious backer units installed as part of tile installations.
   4. Metal edge strips installed as part of tile installations.

B. Related Sections include the following:
   1. Division 03 Section "Cast-in-Place Concrete".
   2. Division 07 Section "Joint Sealants" for additional quality standards for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
   3. Division 08 Section "Access Doors and Panels" for coordination with access doors and panels installation.
   4. Division 09 Section "Gypsum Board" for cementitious backer units.
   5. Division 09 Section "Flooring" Sections for transition strips other than those specified in this Section.
   6. Division 10 Section "Toilet Accessories", and other sections as applicable, for coordination of recessed items installed in tiled walls.
   7. Division 22, for coordination with plumbing fixtures, and floor drains.

1.03 DEFINITIONS

A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. Facial Dimension: Actual tile size (minor facial dimension as measured per ASTM C 499).

C. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.04 REFERENCE STANDARDS


B. ANSI A108.01, Requirements for movement joints.


D. ASTM C1242, Standard guide for selection, design, and installation of dimension stone attachment systems.

E. ASTM C1193, Standard guide for the use of joint sealants.

F. ASTM C1472, Standard guide for calculating movement and other effects when establishing sealant joint width.
1.05 PERFORMANCE REQUIREMENTS
A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as tested per the DCOF AcuTest (ANSI A137.1):
   1. Level Surfaces: Minimum 0.42.
B. All sealants used in floor or traffic applications shall have a Shore A hardness not less than 35.

1.06 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
C. Samples for Initial Selection: For each type of tile indicated. Submit complete line of grout color for selection by Architect. Include Samples of accessories involving color selection.
D. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required.
   2. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches square and mounted on rigid panel. Use grout of type and in color or colors approved for completed work.
   3. Full-size units of each type of trim and accessory for each color and finish required.
   4. Stone thresholds in 6-inch lengths.
   5. Metal edge strips in 6-inch lengths.

1.07 INFORMATIONAL SUBMITTALS
A. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
B. Product Certificates: For each type of product, signed by product manufacturer stating products are suitable for intended application.
C. Qualification Data: For Installer.
D. Material Test Reports: For each tile-setting and -grouting product and special-purpose tile.
E. Letter from sealant manufacturer, stating suitability of products for each application indicated.

1.08 QUALITY ASSURANCE
A. Qualifications of Installers: For cutting, installing and grouting of ceramic tile, use only thoroughly trained and experienced journeyman tile setters who are completely familiar with the requirements of this work, and the recommendations contained in the referenced standards, and who are CTI, CTEF, ACT, or TCNA 5-Star TCAA Trowel of Excellence certified.
B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with the following:
   1. Grout and mortar setting shall comply with, ANSI A108.4 and ANSI A 108.5.
   2. Manufacture all ceramic tile in accordance with Standard Grade Requirements of ANSI 137.1.
   3. ANSI A118.10, Specifications for waterproof membranes
   4. ANSI A118.12 Specifications for Crack Isolation Membranes

C. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.
   1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

D. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer. Including self-leveling underlayments and waterproofing / anti-fracturing membranes.

E. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
   1. Stone thresholds.
   2. Joint sealants.
   3. Cementitious backer units.
   4. Metal edge strips.

1.09 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 requirement in ANSI A137.1 for labeling sealed 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 avoided.

D. Store liquid latexes and emulsion adhesives in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.11 MAINTENANCE MATERIALS

A. Furnish extra materials that are from same production runs as products installed, that match 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 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The following requirements apply for product selection:
1. Basis-of-Design Product: The design for each tile type is based on the product named. Subject to compliance with requirements, provide either the named product or an approved comparable product by another manufacturer.

2.02 PRODUCTS, GENERAL
A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
   1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
   2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the specified product:
D. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, 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.
E. Warpage: No more than one-tenth the length of the measured span of the tile can exhibit more than 25 percent of total allowable warpage.

2.03 TILE PRODUCTS
A. Available Suppliers whose products may be incorporated into the work include but are not limited to the following:
   1. As scheduled for new tile.
B. Wall Porcelain Tile: Glazed porcelain ceramic tile. Size and type as indicated on drawings.
C. Floor Tile: Porcelain tile. Size and type as indicated on drawings.
D. Trim & Special Tile: Provide necessary caps, stops, coves, returns, trimmers, and other shapes as required for a complete installation. Items to be supplied by the same manufacturer supplying the tile.
E. Ceramic Tile: Flat tile as scheduled on drawings.

2.04 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, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to 1/2 inch or less, and finish bevel to match face of threshold.

2.05 WATERPROOFING FOR THIN-SET TILE INSTALLATIONS
A. General: Manufacturer’s standard product that complies with ANSI A118.10, selected from the following;
B. Waterproofing Membrane (Concrete Slabs).
   1. Flexible load-bearing, self-curing liquid rubber polymer and reinforcing fabric to form a seamless, heavy-duty waterproof membrane below a protective surface. Provide continuously under floor tile and behind wall tile:
      a. Laticrete; Hydroban.
      b. MAPEI; Mapelastic AquaDefense.
2.06 WATERPROOFING SYSTEM FOR TILE SHOWER APPLICATIONS

A. Waterproofing system: Provide complete shower waterproofing system for shower pan and wall waterproofing, consisting of 8 mil thick polyethylene membrane with bonded fleece on both sides. Membrane shall meet or exceed the requirements of "American National Standard Specifications for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation A118.10", shall be listed by cUPC, and shall be evaluated by ICC-ES for compliance with local building code requirements. Subject to compliance with requirements, provide Schluter Kerdi system, or approved equal:
2. Seaming membrane: Schluter Kerdi-BAND.
4. Provide pre-formed corner pieces at all intersections of planes, and as required for complete waterproofing system.
5. Provide sealants as recommended by Manufacturer for complete installation.
6. At curbless shower installation, extend membrane 1'-0" beyond shower enclosure.

2.07 SETTING MATERIALS

A. Setting Materials Quality, General: Standards and materials specified herein are to set a minimum acceptable quality standard for setting materials. Contractor may, at Contractor's option and without change in price, propose to provide a higher grade of setting materials that may in Contractor's opinion reduce labor costs, reduce setting time, or afford other benefits in installation. Include for Architect's consideration the reasons for any such proposed revisions of setting materials with product submittal.

B. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
1. Custom Building Products.
2. LATICRETE International Inc.
3. MAPEI Corporation.


D. Latex-Polymer Modified Portland Cement Mortar (Thin Set) for Wall and Floor: ANSI A118.4, consisting of the following:
1. Prepackaged dry-mortar mix containing dry, re-dispersible, ethylene vinyl acetate additive to which only water must be added at Project site. Available products include the following:
   a. MAPEI; Ultraflex 3
   b. Laticrete; 254 Platinum.
2. For wall applications, provide mortar that complies with requirements for nonsagging mortar, ISO 13007; C2TE, in addition to the other requirements in ANSI A118.4.
3. For thin-set application of large format tiles and heavy stone tiles, use LHT mortar.

E. Dry-Set Mortar for Large and Heavy Tile (LHT) large format tile interior floors and walls for all tile > 1SF in size and medium-set tile. Acceptable for use at all interior tile: Comply with
requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 3/32” to 1/2”.
1. Provide prepackaged, dry-mortar mix containing dry, re-dispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
   a. MAPEI; Ultraflex LFT.
   b. Custom Building Products; Natural Stone and Large Tile Premium Mortar.
   c. Laticrete; 4-XLT.

2.08 GROUT MATERIALS:
A. Ready-to-Use, Non-Staining Grout: Pre-Mixed Non-Staining Professional-grade, ready-to-use color consistent quartz aggregate grout, for use with grout joints 1/16” to 1/2” (1.5 to 12 mm) and complying with ANSI A118.6, ANSI A118.7, and ISO 13007; CG2.
1. Available Products:
   a. MAPEI; Flexcolor CQ.
   b. Custom Building Products; Fusion Pro.
   c. Laticrete; Ready-to-Use Grout.
   d. TEC; InColor Advanced Performance Grout

2.09 ELASTOMERIC SEALANTS
A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 7 Section "Joint Sealants."
B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.
C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
1. Where Grout Manufacturer's sealants meet requirements throughout, use Grout Manufacturer's matching color sealants for sealant joints between tiles. Available Products:
   a. MAPEI; Mapesil.
   b. Laticrete; Latasil.
   c. Custom Building Products; Commercial 100% Silicone Caulk.
2. Other Available Products may include:
   a. Dow Corning Corporation; Dow Corning 786.
   b. GE Silicones; Sanitary 1700.
   c. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
   d. Tremco, Inc.; Tremsil 600 White.
D. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.
1. Available Products:
   a. MAPEI; Mapeflex P1 SL.
   d. Pecora Corporation; NR-200 Urexpan.
   e. Tremco, Inc.; THC-900.
E. Joint Backers: Foam joint backer material to prevent sealant bond and form recommended joint cross sectional shape. Round or rectangular with rounded top, and in sizes as appropriate to joint sizes and conditions.
2.10 CEMENTITIOUS BACKER UNITS
A. Provide 5/8” cementitious backer units at all walls to receive tile and on top of plywood subfloor/deck to receive waterproofing and tile. All walls in wet areas complying with ANSI A118.9 in maximum lengths available to minimize end-to-end butt joints re: Division 09 Section “Gypsum Board Assemblies.”

2.11 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. Metal Edge Strips: Metal edge strips with flange for embedding in tile setting material. Provide shapes as noted below, in sizes to match tile and setting-bed thickness and adjacent finish materials at transitions. Subject to compliance with requirements, provide metal strips as manufactured by Schluter.
1. Ceramic Tile to Concrete or other lower floor material: RENO-RAMP by Schluter. Finish: Stainless steel.
2. Top edges of tile (that do not go to ceiling): "QUADEC" by Schluter. Finish: Stainless steel.
   a. Provide connectors, end caps, and inside and outside corner kits. Where there is adjacent vertical tile trim, select corner kits to match the adjacent vertical trim.
5. Inside Corners shall be soft tile sealant joints to match grout color.
6. Sealant movement joints shall be soft tile sealant joints to match grout color.
   a. Square Drains in Tile at tile floors: Refer to Division 22 and Plumbing Fixture Schedule Schluter Kerdi-Drain or approved equal.
C. 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.

2.12 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

3.01 EXAMINATION
A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
   1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
2. 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 before installing tile.
3. 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. Contractor shall apply leveling coat or dry-set mortar over wall and floor surfaces which may vary more than 1-inch in 10 feet. Installation constitutes acceptance of the substrate.

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

3.02 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Provide concrete substrates for tile floors, installed with adhesives or thin-set mortar that complies with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
   1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
   2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, 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.

3.03 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
   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 composed of tiles 8 by 8 inches or larger.
   2. Comply with ANSI standards for tolerances except as follows:
      a. Lippage: Lippage at floor and wall tile shall not exceed 1/32" between adjacent tiles.
      b. Unless specifically noted otherwise in Drawings, where tiles of different gage thickness are installed adjacent to each other on the same surface, install with thicker medium set mortar bed at the thinner tile as required to install surfaces of adjacent tiles flush, to within the maximum allowed tile lippage.


C. 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.

D. 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.
E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints per approved shop drawings, and in compliance with TCNA handbook recommendations where indicated during installation of settings materials, mortar beds, and tile. Do not saw-cut joints after installing tiles. Do not allow grout, setting materials, or other hard materials to restrict movement or bridge across at movement joints.
   1. Install sealant materials per manufacturer's installation instructions and industry standards. Clean and prime surfaces as recommended by manufacturer. Do not exceed temperature limitations, including where required shading of joints until after cured where joints are exposed to direct sunlight.
   2. Locate joints at inside corners, in tile surfaces directly above joints in concrete substrates, and per reference standards.
   3. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants."
   4. Install movement joints with appropriate joint backer material.
   5. Install movement joints per details in TCNA EJ171, except where pre-fabricated joint profiles are indicated.
   6. Sealant profile shall be slightly concave.
   7. In general, movement joints are recommended at 25’ each direction at interior spaces. Tile work exposed to direct sunlight, heat or moisture should place movement joints at 12’ maximum each direction.

G. Grout tile to comply with requirements of the following tile installation standards:
   1. For ceramic tile grouts (sand-portland cement; dry-set, commercial portland cement; and latex-portland cement grouts), comply with ANSI A108.10.
   2. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

H. Where indicated, install cementitious backer units and treat joints to comply with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.04 ANTI-FRACTURE AND WATERPROOFING MEMBRANES INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and waterproofing manufacturer’s written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.

B. Install water proofing membrane under and behind floor tile and turned up 9" vertical behind wall tile at restrooms and showers. Also install waterproofing at floor drains.
   1. At showers, install waterproofing system throughout the shower including behind wall tile, and extend waterproofing system behind adjacent tile at least 9" beyond the shower on all sides.

C. Install Anti-Fracture membrane at all floor tile not otherwise indicated for waterproofing membrane installation.

D. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.
   1. Stop up shower drains and flood shower pans to test waterproofing to be leak-free for minimum of 24 hours duration, or greater where required by authorities having jurisdiction, prior to tile installation.

3.05 FLOOR TILE INSTALLATION
A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCNA installation methods and ANSI A108 Series of tile installation standards.

1. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
   a. Tile floors composed of tiles 8 by 8 inches or larger.

B. Joint Widths: Install tile on floors with the following joint widths:
   1. Ceramic Tile: 1/8 inch
   2. Unless otherwise approved by Architect, accurately cut tile to install with joint widths between tile and floor drains, floor sinks, and similar items in floors, to the same joint widths as in the tile field.

C. Tile Pattern: As indicated in Drawings

D. Metal Edge Strips: Provide at locations other than restrooms where exposed edge of tile flooring meets carpet, wood, vinyl composition tile, or other flooring that finishes flush with top of tile. Install with setting flanges embedded in the tile setting material.
   1. Use full length pieces to the extent possible in order to minimize the number of joints.
   2. Unless otherwise noted, install edge strips flush with faces of tile to within maximum lippage tolerances as specified for tile.
   a. Also seal cementitious grout after grouting using grout sealer product.

3.06 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCNA installation methods and ANSI setting-bed standards.

B. Joint Widths: Install tile on walls with the following joint widths:
   1. Ceramic Tile: 1/8 inch

C. Tile Pattern: As indicated in Drawings.

D. Metal Trim Strips: Install at all locations indicated or as required to conceal exposed edge of tile:
   1. Use full length pieces to the extent possible in order to minimize the number of joints.
   2. Unless otherwise noted, install edge strips flush with faces of tile to within maximum lippage tolerances as specified for tile.
   3. Install all strips and transitions set in mortar beneath tile, and per manufacturer's instructions.
   4. At top of tile wainscots and other exposed edges of wall tile, install caulk joint between metal trim and wall. Do not grout to wall. Coordinate color with Architect and adjacent finishes.

3.07 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove epoxy and latex-portland cement grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.08 FLOOR TILE INSTALLATION SCHEDULE

A. Tile Installation F112: Interior floor installation on concrete; LHT mortar on crack isolation or waterproofing membrane; TCNA F112.
   1. Locations: At Large and Heavy Tile
   2. LHT Mortar: Latex-portland cement mortar.
   3. Grout: Ready-to-use, Non-staining Grout
   4. Membrane: Use crack isolation membrane typical

B. Tile Installation: Interior floor installation on concrete; thin-set mortar on crack isolation membrane; TCNA F125-Full.
   1. Locations: Typical for tile that is not large format or natural stone, unless otherwise noted.
   2. Thin-Set Mortar: Latex-portland cement mortar.
   3. Grout: Ready to use, stain-free grout.
   4. Membrane: Use crack isolation membrane typical

3.09 WALL TILE INSTALLATION SCHEDULE

A. Tile Installation W244C: Interior wall installation over cementitious backer units; thin-set mortar; TCNA W244C.
   1. Location: As indicated at locations
   2. Thin-Set Mortar: Latex-portland cement mortar.
   3. Grout: Ready-to-use, Non-staining Grout

END OF SECTION 09 30 13
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of
   the Specifications to ensure efficient and orderly installation of each part of the Work that
   depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Provide acoustical ceilings as shown on the drawings and as herein specified.

B. Related Sections include the following:
   1. Division 09 Section - Gypsum Board Assemblies, for gypsum board ceilings support
      system.
   2. Division 21 through 28 Mechanical and Electrical Sections, for coordination with devices
      installed in grid ceilings.

1.03 QUALITY ASSURANCE

A. Fire Hazard Classification: Maximum flame spread, Class A (less than 25) as tested in
   accordance with ASTM E-84 and per Fed. Spec. SS-S-118a.

1.04 SUBMITTALS

A. Product Data: Manufacturer's product specifications and installation instructions for each
   acoustical ceiling material required, and for each suspension system, including certified
   laboratory test reports and other data as required to show compliance with these
   specifications.

B. Samples: Set of 4" x 4" square samples for each acoustical unit required, showing full range
   of exposed color and texture to be expected in completed work.

1.05 COORDINATION

A. Contractor shall coordinate connection of lighting and electrical devices to grid. Where
   lighting fixtures are provided with integral clips, install lighting fixture with the clip
   attachments and not with screws through grid tees.

1.06 MAINTENANCE MATERIALS

A. Provide 3% full tiles, each type (minimum one box) each color, texture and style of ceiling
   tiles.

PART 2 - PRODUCTS

2.01 CEILING TILE AND GRID

A. Acoustical Panels:
   1. Type AC1: 24" x 24" x 5/8" mineral fiber tile Class A flame spread made for a lay-in
      grid suspension system. Panel design is Armstrong #1774 "Dune", with Beveled Tegular
      edge profile, Color: White.
   a. Use with Grid Type 1.
B. Lay-in suspension system: Exposed steel members made for use with panel types specified. System supplied with all main runner tees, cross tees, wall angles, clips, connectors, fastening and hangar wires. Subject to compliance with requirements, provide the named products below or equal by System Conwed Corp., Donn Products, Chicago Metal, Flangeclamp Corp. in finishes as specified below:
   1. Grid Type 1: Grid to be 24" x 24" pattern with white finish. Armstrong’s “Suprafine ML” 15/16” exposed tee, or approved equal.

2.02 MISCELLANEOUS MATERIALS
A. Uplift Bracing and Retention Clips: Provide uplift bracing and retention clips designed to prevent tiles from dislodging due to wind or air pressure changes at exterior grid, grid in airlock vestibules, and in similar locations subject to wind or sudden changes in air pressure.
   1. Provide retention clips at all plank type tile as recommended by Manufacturer.
      a. Equal to Armstrong Universal Hold-Down clip for typical air pressure uplift locations unless otherwise recommended.

B. Edge Treatment for cut edges of tegular and grooved edge ceiling tiles and planks: Manufacturer's recommended touch up paint.

PART 3 - EXECUTION
3.01 INSTALLATION
A. Ceiling grids and acoustical panels completely installed in all areas indicated. Ceiling plenum shall be completely enclosed from adjoining conditioned space by structure, partitions, and/or acoustical panels.

B. Suspension systems installed by direct suspension from structural systems in accordance with manufacturer's specification. Hanger wire shall support no greater than 16 square feet. Install additional hangars at ends of each suspension member, at each end of light fixtures, and 6 inches from vertical surfaces. Do not splay wires more than 5 inches in a 4 foot drop. Bottom of surfaces shall be flush and level. Miter corners where wall moldings intersect.

C. Install grid with uplift bracing and retention clips where required.
   1. At all spaces subject to sudden change in pressure.

D. The plumbing and heating contractors shall not utilize hangers or framing of suspension system. The electrical contractor may utilize suspension system for lay-in fixture installation but shall furnish two supplementary hangers per fixture for maintaining maximum load deflection. Electrical contractor shall not utilize tile as sole support for any ceiling-mounted electrical device. All ceiling-mounted electrical devices shall be supported with brackets attached to tees.

E. Ceilings laid out as shown on the drawings, however, if not specifically shown, ceilings laid out from center of room in both directions so that cut tiles are equal at all edges. Place materials to have full bearing on suspension members.

3.02 INSPECTION
A. Following installation, soiled or discolored units cleaned to match adjacent perfect material. Any broken or damaged material which cannot be corrected by cleaning, removed and replaced with perfect material.

END OF SECTION 09 51 00
SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Provide all resilient flooring materials with accessories as shown on the drawings and as herein specified.
B. Related Sections include the following:
   1. Division 1, Section 01 31 00 Project Management and Coordination – (Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.)
   2. Division 06 Section “Architectural Woodwork”, for coordination of resilient base applied to woodwork toe kicks and bases.
   3. Division 09 Section “Gypsum Board Assemblies.”
   4. Division 09 Section “Painting.”

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING
A. Materials delivered to job site in manufacturer's unopened containers with labels intact. Store materials at minimum temperature of 70°F in all areas for at least 48 hours prior to installation.

1.04 JOB CONDITIONS
A. Environmental Requirements: Maintain temperature of 70°F in all areas for at least 48 hours before, during and after installation. Maintain a temperature of 60°F after installation.

1.05 SUBMITTALS
A. Submit the following samples of each type, color, and pattern of resilient flooring and accessories required, showing full range of color and pattern variations.
   1. Samples for Selection: Manufacturer's material color samples for color selection.

1.06 QUALITY ASSURANCE
A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.07 EXTRA MATERIALS
A. Provide one continuous uncut 40' roll, of each color and type resilient base installed.

PART 2 - PRODUCTS

2.01 MATERIALS
A. Rubber Base: 1/8" thick base complying with FS SS-W-40a, Type I with preformed external and internal corners and stops equal to that manufactured by Tarkett, Straight base (toeless) at carpeting and cove base (toe) elsewhere. Reference drawings for type and color approved equal by Roppe, Armstrong, or Flexco, Architect to approve substitution.
   1. 4" high typical unless otherwise indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
   1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      a. Cove Base Adhesives: Not more than 50 g/L.

C. All materials best grade, with no second grade, off goods or remnants allowed.

PART 3 - EXECUTION

3.01 INSPECTION AND COORDINATION
A. All surfaces receiving resilient base and accessories shall be examined by the installer for any defects which in his opinion, he considers detrimental to a proper installation. Any defects found during inspection must be corrected prior to installation; this includes any sanding, leveling, or surface repairs required. Installation constitutes acceptance of substrate conditions.

B. Verify that wall sheathing is installed with sufficiently small gap to floor slabs, or with acoustical sealant or filler applied, to prevent bottom of base from getting pushed in under the sheathing.

C. Where acoustic sealant is indicated to be applied behind wall base, do not install wall base until acoustical sealant is installed and cured.

D. Apply new wall base after painting of walls.

3.02 INSTALLATION - GENERAL
A. Clean all surfaces of grease, dirt, paint and other objectionable matter. Fill and level any holes, cracks, joints and depressions in substrate with leveling material. Provide backer material if necessary.

B. Accessories installed in strict accordance with manufacturer's printed instructions.

3.03 INSTALLATION - WALL BASE
A. Tightly bond continuous base to substrate with contact at horizontal and vertical surfaces.
   1. Base with puckers, bird months, pushed in at base, or other visible delaminations from substrates or other imperfections are not acceptable.

B. Apply wall base to walls, casework/cabinets and other permanent fixtures in rooms or areas where base is required.

C. Where ends of cove base abut door jambs and similar construction, neatly miter cut the cove flush with the face of door jamb or adjacent surface at 45 degree angle as required to eliminate an exposed edge that can be caught on mops, brooms or boots.

3.04 PROTECTION AND CLEANING
A. Rubber base and adjacent surfaces shall be cleaned removing all adhesive or other defects.

B. Replace base that can not be cleaned.
END OF SECTION 09 65 13
SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Provide complete surface preparation, priming, field painting and sealing of exposed exterior and interior items and surfaces.

1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

2. Examine specifications for various other trades and their provisions regarding their painting. Surfaces that are left unfinished by other sections of specifications shall be painted or finished as a part of this section.

B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

C. Do not paint prefinished items and finished metal surfaces except where otherwise noted in Drawings or specifications. Do not paint concealed surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:

   a. Architectural woodwork.
   b. Finished mechanical and electrical equipment.
   c. Light fixtures.
   d. Cedar Sidings
   e. Prefinished roof panels

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

   a. Foundation spaces.
   b. Furred areas.
   c. Ceiling plenums.
   d. Pipe spaces.
   e. Duct shafts.

3. Finished metal surfaces include the following:

   a. Anodized aluminum.
   b. Stainless steel.
   c. Chromium plate.
   d. Copper and copper alloys.
   e. Bronze and brass.

4. Operating parts include moving parts of operating equipment and the following:

   a. Valve and damper operators.
b. Linkages.
c. Sensing devices.
d. Motor and fan shafts.
5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:
1. Division 4 Section “Concrete Finishes”.
2. Division 4 Section “Unit Masonry Assemblies”.
3. Division 5 Section "Structural Steel" for shop priming structural steel.
4. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
5. Division 6 Section "Interior Architectural Woodwork" for shop priming interior architectural woodwork.
6. Division 7 Section "Joint Sealant ".
7. Division 8 Section "Flush Wood Doors ".
8. Division 8 Section "Hollow Metal Doors and Frames" for factory priming steel doors and frames.
9. Division 9 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.
10. Division 9 Section “High Performance Coatings”, for coordination of surfaces receiving high performance paint finishes.
11. Division 32 Section "Pavement Accessories" for traffic-marking paint.
12. Additional Divisions requiring field applied paint finishes.

1.03 DEFINITIONS
A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
   1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
   2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
   3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
   4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.04 SUBMITTALS
A. Product Data: For each paint system indicated. Include block fillers and primers.
   1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
   2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
   1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
   2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
   3. Submit 2 samples on the following substrates for Architect's review of color and texture only:
a. Masonry: 6-by-10-inch samples of masonry, with mortar joint in the center, for each finish and color. (Field installation acceptable).

b. Painted Gypsum Board: 8-inch-square samples for each color and material on hardboard.

c. Stained Wood: 6-by-10-inch samples of natural- or stained-wood finish on representative Select White Maple and Cedar surfaces.

d. Ferrous Metal: 4-inch-square samples of flat metal and 8-inch-long Samples of solid metal for each color and finish. (Field installation acceptable).

C. Qualification Data: For Applicator.

D. Closeout Submittals:
   1. The Contractor shall furnish the Owner a list of Manufacturers, materials, and colors for each product used and either draw down painted sheets or printed color swatch samples of the colors used on the project at project completion, for inclusion in the O&M manuals.
   2. Extra Materials, as specified. Obtain Owner's signed transmittal upon delivery, listing quantities of each material provided.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.

   1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
      a. Wall Surfaces: Provide samples on at least 100 sq. ft.
      b. Small Areas and Items: Architect will designate items or areas required.
      c. Portion of all wood to be finished or restored, including windows, doors, frames, rails, etc.

   2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
      a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.

   3. Final approval of colors will be from benchmark samples.


E. Materials shall be manufacturer's best grade of respective paint types.

F. Gloss levels for paints required are as per the National Paint and Coatings Association.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Manufacturer's stock number and date of manufacture.
   4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at an ambient temperature between 45 and 95 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.07 PROJECT CONDITIONS
A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
D. Provide adequate ventilation of spaces while applying primer and finish coats.
E. All application of coatings shall be done under adequate illumination.

1.08 EXTRA MATERIALS
A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
   1. Quantity: Furnish Owner with an additional 3 percent, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS
2.01 MANUFACTURERS
A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.
C. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
   1. Basis of Design: Sherwin-Williams Co. (Sherwin-Williams), or approved equal from list of manufacturers below:
      a. Benjamin Moore & Co. (Benjamin Moore).
      b. PPG Industries, Inc. (Pittsburgh Paints).
      c. Kelly-Moore Paint Co. (Kelly-Moore).
      d. Coronado Paint Company (Coronado).

2.02 PAINT MATERIALS, GENERAL
A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: As indicated on Drawings and/or match Architect's samples.

D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.03 EXTERIOR PRIMERS
   1. Sherwin-Williams; Pro-Cryl Universal Primer B66-310 Series: Applied at a dry film thickness of not less than 3.0 mils.

B. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.
   1. Sherwin-Williams; Pro-Cryl Universal Primer B66-310 Series: Applied at a dry film thickness of not less than 3.0 mils.

   1. Adhesion Primer must be topcoated within 14 days of primer application.


E. Exterior Primer for Wood containing knots: Sherwin-Williams Exterior Oil-Based Wood Primer Y24W8020. Applied at dry film thickness of not less than 2.3 mils.

2.04 EXTERIOR FINISH COATS
   1. Sherwin-Williams; Pro Industrial Acrylic Semi-Gloss B66W661 Series: Applied at a dry film thickness of not less than 2.5 mils.


C. Architecturally Exposed Steel: Refer to Division 09 “High Performance Coatings”.

2.05 INTERIOR PRIMERS
A. Interior Concrete Primer: Factory-formulated alkali-resistant acrylic-latex interior primer for interior application.
1. Sherwin-Williams; Loxon Concrete & Masonry Primer B24W8300: Applied at a dry film thickness of not less than 3.0 mils.

B. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
   1. Sherwin-Williams; ProMar 200 Zero VOC Latex Wall Primer B28W2600 Series: Applied at a dry film thickness of not less than 1.5 mils.

   1. Sherwin-Williams; Pro-Cryl Universal Primer B66-310 Series: Applied at a dry film thickness of not less than 3.0 mils.

D. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
   1. Sherwin-Williams; Pro-Cryl Universal Primer B66-310 Series: Applied at a dry film thickness of not less than 3.0 mils.

2.06 INTERIOR FINISH COATS

A. Interior Eg-Shel Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for interior application: ProMar 200 Zero VOC Interior Latex Eg-Shel. Applied to a dry film thickness of not less than 1.6 mils.


C. Interior Full-Gloss Alkyd Enamel for Wood and Metal Surfaces: Factory-formulated full-gloss alkyd interior enamel.

D. Interior Full Gloss Epoxy:

E. Interior DryFall, Water Based Flat, for Galvanized Steel Decking: Sherwin-Williams Pro Industrial Waterborne Acrylic Dryfall B42W81.

2.07 MISCELLANEOUS PAINT PRODUCTS

A. Semi-transparent water repellent wood preservative stain shall be Olympics’ Semi-Transparent Oil Base Stain, or equal.

B. Other materials such as linseed oil, turpentine and shellacs shall be pure and of highest quality.

C. Exterior Concrete Block Protective Coating: One part, water based, cross linked copolymer coating shall be Rainguard Products Company's "Vandl-Guard Graffiti Resistant Coating", or approved equal.

D. Concrete Block Sealer: Waterproofing clear penetrating sealer shall be "Rainguard Micro-Seal" as manufactured by Rainguard Products Co., or approved equal. Install at coverage rate determined adequate by manufacturer's representative.

E. Sealer Thinner: Sonneborne's "Reducer 990", or approved equal.

F. Wood Sealer: Penetrating water-repelling sealer shall be Olympic, "Water Guard".

G. Waterbased Epoxy: Catalyzed epoxy meeting requirements of ASTM D3730, equal to Sherwin Williams B67 Series.
PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
   1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
   2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
   1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.02 PREPARATION
A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
   1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
   1. Provide barrier coats over incompatible primers, or remove and re-prime.
   2. Cementitious and Masonry Materials: Prepare brick, concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
      a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
      b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
   3. Wood: Clean new or existing surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view down to consistent substrate for intended finish. Ensure smooth surface remains and remove all residual dust.
      a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
      b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, trim, rails, doors, frames and windows.
      c. If transparent finish is required, backprime with spar varnish.
d. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
   a. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
   1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
   2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
   3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Concrete floor surfaces to remain exposed shall be cleaned and properly acid etched per floor sealer manufacturer's instructions. Fill and patch holes, crevices, cracks, etc. Remove any paint, soil, loose material and dust. Remove oil or grease with a hot TSP solution and rinse thoroughly. Floor to be completely dry prior to etching with muriatic acid and water solution.

3.03 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
   1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
   2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
   3. Provide finish coats that are compatible with primers used.
   4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
   5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   6. Paint interior surfaces of ducts with a flat, non-specular black paint where visible through registers or grilles.
   7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
   8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
   9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
   10. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.

2. Omit primer over metal surfaces that have been shop primed and touchup painted.

3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.

2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:

1. Uninsulated metal piping.

2. Uninsulated plastic piping.

3. Pipe hangers and supports.

4. Tanks that do not have factory-applied final finishes.

5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.

6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.

7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

8. New rooftop gas piping.

9. All existing and new exterior conduit, gas, water and similar piping at face of exterior walls.

G. Electrical items to be painted include, but are not limited to, the following:

1. Switchgear.

2. Panelboards.

3. Electrical equipment that is indicated to have a factory-primed finish for field painting.

H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or
unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
   1. Provide satin finish for final coats.

L. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

M. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.04 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
   1. After completing painting, clean glass and paint-splattered surfaces. Remove splattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.05 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
   1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces prior to final inspection. Comply with procedures specified in PDCA-P1.

3.06 EXTERIOR PAINT SCHEDULE

A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
   1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a rust-inhibitive primer.
      b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.

B. Zinc-Coated and Aluminum Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
   1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over universal metal primer.
   2. Refer also to Division 09, Section “High Performance Coatings”, for surfaces that receive high performance coatings rather than coatings specified in this Section.

3.07 INTERIOR PAINT SCHEDULE

A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
1. Eggshell Latex Finish: (Typical where not otherwise noted) Two finish coats over a primer.
2. Semi-Gloss Epoxy Finish: (at Storage, and restrooms): Two finish coats over primer.
3. Flat Finish: (at Ceilings): Two finish coats over primer.

B. Ferrous Metal & Zinc-Coated Metal: Provide the following finish systems:

C. Dryfall Paint at areas of painted exposed to deck structure: Paint structure, deck, mechanical, plumbing, and other exposed metal items below structure as appropriate: 1 or 2 finish coats as required for complete coverage and consistent appearance, over 1 coat primer:
1. Primer: Alkyd or Acrylic primer as recommended by Manufacturer for metal substrate types.
2. Finish Coats: Dryfall Paint (Sherwin-Williams Pro Industrial Waterborne Acrylic Dryfall B42W00181).

D. Interior Concrete Floors: Reference Section 03 “Concrete Finishes”.

END OF SECTION 09 91 00
SECTION 09 96 00 - HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY
A. Section Includes:
   2. Application of primers, intermediate coats, and top coats for each coating system.
B. Coating Systems Include:
   1. Gloss Urethane Metal Coating - apply to exterior metal frames (all exposed exterior surfaces).
   2. Low Gloss Urethane Metal Coating - apply to exterior masonry lintels, shelf angles, and downspout boots.
C. Related Sections include the following:
   1. Division 09 Section - Painting, for special-use coatings and general field painting.

1.03 REFERENCES
A. Steel Structures Painting Manual, Vol. 2; Systems and Specifications; Steel Structures Painting Council (SSPC); 2008 Edition.

1.04 SUBMITTALS
A. Product Data: Manufacturer's technical data sheets for each coating.
   1. Material analysis including vehicle type & percentage by weight, and by volume of vehicle, resin, and pigment.
   2. Application instructions including mixing, surface preparation, compatible primers and topcoats, recommended wet & dry film thickness, and recommended application methods.
B. Color and Texture Samples:
   1. Provide for each coating system, color, and texture. Apply to representative substrate samples.
   2. Label each sample with coating name and color.
   3. Prepare samples to show bare, prepared surface and each successive coat.

1.05 QUALITY ASSURANCE
A. Installer: A company skilled in the application of special coatings whose installations have performed in a satisfactory manner under comparable conditions.
B. Master Painters Institute (MPI) Standards:
   1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

1.06 DELIVERY, STORAGE AND HANDLING
A. Deliver materials in manufacturer’s original containers bearing coating name and color, material composition data, date of manufacture, legal notices if applicable, and mixing, thinning, & application instructions.

B. Storage:
   1. Store materials in an orderly fashion and in clean, well-closed containers with labels intact.
   2. Maintain above 40 degrees F. Do not allow materials to freeze.

1.07 PROJECT CONDITIONS
A. Apply coatings only under the following environmental conditions:
   1. Air and surface temperatures between 50 & 95 degrees F, or more restrictive when recommended by coatings manufacturer.
   2. Surface temperature is at least 5 degrees F above dew point, or more restrictive when recommended by coatings manufacturer.
   3. Relative humidity is less than 85 percent, or more restrictive when recommended by coatings manufacturer.

B. Do not apply coatings during inclement weather.

1.08 MAINTENANCE MATERIALS
1. Furnish an additional 5%, but not less than one properly labeled & sealed gallon of each type finish coat in each color, taken from batch mix furnished for the work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Provide all products of this section from a single manufacturer.
   1. The Basis-of-Design products listed are by Sherwin-Williams.

B. The brand-name products listed in the schedule at the end of this section and made by the following are acceptable manufacturers.
   2. Tnemec Company, Inc.
   3. PPG Architectural Finishes.

2.02 PRODUCTS
A. Gloss Urethane Coating.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Tnemec Oakite 747 Wash Primer, Series N69 Hi-Build Epoxoline II Epoxy Primer, Tnemec Series 1074 Endura-Shield II Finish Coat
      b. PPG Poly Clutch 97-687 Wash Primer, Pitt-Guard Rapid Coat 95-245 Epoxy Primer, Pitthane Ultra Gloss Urethane 95-812 Finish Coat

B. Low Gloss Urethane Coating.
   1. Products: Subject to compliance with requirements, provide one of the following:
a. Tnemec Series 135 Chembuild Primer, Series N69 Hi-Build Epoxoline II Intermediate Coat, Series 1075 Endura-Shield II Finish Coat

PART 3 - EXECUTION

3.01 EXAMINATION
A. Verify that surfaces and conditions are ready for work in accordance with the contract documents and coating manufacturer's recommendations.
B. Prior to commencement of work, examine surfaces scheduled to be finished.
   1. Report any unsatisfactory conditions in writing.
   2. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the applicator.
   3. Beginning work on an area will be deemed acceptance of surfaces in that area.

3.02 PREPARATION
A. Do not apply coatings to labels that identify equipment, fire-resistance ratings, etc.
B. Provide protection for non-removable items not scheduled for coating.
C. Protect surfaces not scheduled for coating. Clean, repair, or replace surfaces inadvertently spattered or coated.

3.03 SURFACE PREPARATION
A. General: Clean and prepare surfaces as specified. Achieve the surface profile recommended by the coating manufacturer for optimum adhesion and proper appearance.
B. All Surfaces: Ensure surfaces are clean, dry and free of oil, grease and other contaminants.
C. Ferrous Metal:
   1. Clean and prepare surface profile in accordance with applicable SSPC specifications:
      a. Frames: SSPC-SP 2 Hand Tool Cleaning, SSPC-SP 3 Power Tool Cleaning.
      b. Repair shop-primed ferrous metal by cleaning as per SSPC-SP6 Commercial Blast Cleaning or SSPC-SP11 Power Tool Cleaning to Bare Metal obtaining a minimum 1.5 mil anchor profile, angular, not peened.
D. Nonferrous Metal: Solvent clean surfaces in accordance with SSPC-SP 1 Solvent Cleaning specifications. If recommended by coating manufacturer to ensure adhesion, brush off or blast clean in accordance with SSPC-SP 7. Prepare and prime any rusted existing surfaces in accordance with coating manufacturer's instructions.

3.04 MIXING AND THINNING
A. Remove and discard any skin formed on surface of coatings in containers. Discard any containers where skin comprises 2 percent or more of the remaining material.
B. Combine multi-component paints in quantities needed for use within the manufacturer's recommended pot life at the anticipated application temperatures. Discard remaining mixed material after pot life has expired.
C. Do not add thinner except as specifically recommended (not merely permitted) by the coating manufacturer for proper coating application under the circumstances prevailing at the project
site when application equipment recommended by the coating manufacturer is employed. Use only quantities and types of thinner recommended.

D. Mix materials using mechanical mixers in accordance with coating manufacturer's instructions. Agitate mixed materials during application if recommended by manufacturer.

E. Strain pigmented coatings after mixing except where mechanical application equipment is provided with effective strainers.

### 3.05 APPLICATION

**A. General:**

1. Apply coatings using brush only. Roller or spray application not permitted unless approved in writing.

2. Full uniform coverage required.

3. Employ application equipment that is clean, properly adjusted, in good working order, and of the type recommended by the coating manufacturer.

4. Apply successive coats after adequate cure of the preceding coat and within recommended recoating time.

**B. Film Thickness:** Apply each coat to achieve the dry film mil (DFM) thickness per coat indicated in the schedule at the end of this section. Application rates of excess thickness and fewer numbers of coats than specified will not be accepted.

1. The dry film mil thicknesses shown in the schedule are per each coat.

2. Where a thickness range is specified, the dry film thickness actually applied shall fall within the specified range when measured at any point, and the average dry film thickness actually applied to the entire surface shall be equal to the midpoint of the range specified plus or minus 10 percent.

3. Where a single thickness value is specified, the dry film thickness actually applied, when measured at any point, shall be equal to the specified value plus or minus 10 percent.

**C. Prime, First, or Bottom Coats:**

1. Ferrous and Nonferrous Surfaces: Either before or after applying prime coat but before applying successive coats, stripe paint edges, corners, mechanical fasteners, and welds using specified primer.

2. Before applying successive coats, touch-up connections, fasteners, and damaged areas using specified primer.

3. Where first coat shows signs of suction spots or poorly sealed areas, reapply first coat material to adequately seal surface before proceeding with intermediate and top coats.

**D. Miscellaneous:**

1. Completed coatings shall be free of defects such as runs, sags, lap or brush marks, holidays, and skips.

2. Apply coatings according to the schedule at the end of this section and as otherwise indicated. Coat all similar surfaces not specifically mentioned unless specifically exempted.

**E.** Apply coatings to match approved mock-ups.

**F.** Remove coatings not in compliance with this specification. Re-clean and re-prepare surfaces as specified, and then apply coatings to comply with the contract documents.

### 3.06 CLEANING

**A.** Clean work area on a daily basis. Dispose of spent materials and empty containers.

**B.** Remove all trace of coatings inadvertently applied to adjacent surfaces not scheduled to be coated. Remove by appropriate methods that do not damage surfaces.
3.07 PROTECTION

A. Protect work against damage until fully cured. Provide signs identifying wet surfaces until surfaces are adequately cured.

B. Shortly before final completion, examine surfaces for damage to coatings and restore coatings to new, undamaged condition.
   1. Touch-up of minor damage will be acceptable where, in the opinion of the Architect, the result is not visibly different from surrounding surfaces. Recoat entire surface where result is different either in color, sheen, or texture.

3.08 SCHEDULE

A. PRIMER, INTERMEDIATE, AND TOP COAT COLORS
   1. Except where coating materials cannot be tinted, tint each successive (primer, intermediate, top) coat of paint a sufficiently contrasting color to facilitate identification of complete coating coverage. The preceding coat may be in the same color family, but shall be noticeably different. Provide additional top coats without change in Contract Price if necessary to achieve complete hiding and uniform sheen.
   2. Top coat colors are indicated on the drawings and schedules. For approval of actual colors, see sample and mock-up requirements specified above.
   3. Top coat colors of manufacturers listed on the Finish Schedule (or elsewhere) indicate the required color, only, and do not indicate the required brand name product, which shall be as specified below.

B. GLOSS URETHANE COATINGS
   1. Location
      a. Apply to exterior metal frames (all exposed exterior surfaces)
   2. System Description:
      a. Wash primer on galvanized surfaces.
      b. Epoxy primer.
      c. Epoxy intermediate coat.
      d. Urethane top coat.
   3. Sherwin-Williams:
      a. Wash Primer for Non Ferrous Metals: B71Y1 DTM Wash Primer.
      b. Epoxy Primer: B58-600 Series Macropoxy 646 Fast Cure Epoxy, DFT 3.0 to 10.0 mils. (336 g/l)
      c. Intermediate Coat: B58-600 Series Macropoxy 646 Fast Cure Epoxy, DFT 3.0 to 10.0 mils. (336 g/l)
      d. Gloss Finish Coat: 1) B65-600 Series Acrolon 218 HS; DFT 3.0 to 6.0 mils. (320 g/l)
   4. Tnemec:
      a. Wash Primer for Non Ferrous Metals: Oakite 747.
      b. Epoxy Primer: Series N69 Hi-Build Epoxoline II, DFT 2.0 to 3.0 mils. (285 g/l)
      c. Intermediate Coat: Series N69 Hi-Build Epoxoline II, DFT 2.0 to 3.0 mils. (285 g/l)
      d. Gloss Finish Coat: 1) Series 1074 Endura-Shield II; DFT 2.0 to 3.0 mils. (297 g/l)
   5. PPG:
      a. Wash Primer for Non Ferrous Metals: Poly Clutch Wash Primer 97-687. (728 g/l)
      b. Epoxy Primer: Pitt-Guard Rapid Coat Epoxy coating 95-245, DFT 2.0 3.0 mils. (263 g/l)
      c. Intermediate Coat: Pitt-Guard Rapid Coat Epoxy coating 95-245, DFT 4.0 7.0 mils. (263 g/l).
      d. Gloss Finish Coat: 1) Pittthane Ultra Gloss Urethane 95-812, DFT 2.0 to 3.0 mils. (241 g/l)

C. LOW GLOSS URETHANE COATING
1. Apply system to all exposed portions of steel lintels, shelf angles or other horizontal / vertical steel not part of window system.

2. Where masonry preparation requires removal of mortar from joint between steel and masonry, apply system to top surface and all steel surfaces exposed.

3. System Description:
   a. Chemical conversion treatment on ferrous surfaces.
   b. Universal primer, brush apply - no roller or spray.
   c. Epoxy intermediate coat, brush apply - no roller or spray.
   d. Urethane top coat, brush apply - no roller or spray.

4. Sherwin-Williams:
   a. Chemical Conversion Treatment on Ferrous Surfaces: not required.
   b. Epoxy Primer: B58-600 Series Macropoxy 646 Fast Cure Epoxy, DFT 5.0 to 10.0 mils. (336 g/l)
   c. Intermediate Coat: B58-600 Series Macropoxy 646 Fast Cure Epoxy, DFT 5.0 to 10.0 mils. (336 g/l)
   d. Low Gloss (semi-gloss) Finish Coat: 1) B65-350 Series Hi-Solids Polyurethane; DFT 3.0 to 5.0 mils. (315 g/l)

5. Tnemec:
   a. Chemical Conversion Treatment on Ferrous Surfaces: not required.
   b. Primer: Series 135 Chembuild, DFT 3.0 to 4.0 mils. (139 g/l)
   c. Intermediate Coat: Series N69 Hi-Build Epoxoline II, DFT 2.0 to 3.0 mils. (285 g/l)
   d. Low Gloss (semi-gloss) Finish Coat: 1) Series 1075 Endura-Shield II; DFT 2.0 to 3.0 mils. (220 g/l)

6. PPG:
   b. Primer: PittGuard DTR Epoxy Coating 97-145, DFT 4.0 to 7.0 mils. (128 g/l)
   c. Intermediate Coat: Pitt-Guard Rapid Coat Epoxy coating 95-245, DFT 2.0 3.0 mils. (263 g/l).
   d. Low Gloss (semi-gloss) Finish Coat: 1) Pitthane HB Semi-Gloss Urethane 95-8800, DFT 2.0 to 5.0 mils. (291.6 g/l)

END OF SECTION 09 96 00
SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Work includes all labor, materials, equipment and services necessary to furnish and install all signage as shown on the Drawings and as herein specified.

B. Related Sections include the following:
   1. Division 05 - Section "Metal Fabrications", for vehicular sign posts.
   2. Division 06 - Section "Rough Carpentry", for blocking in walls.
   3. Division 10 - Section "Safety Specialties", for fire extinguisher / cabinets and AED signage.
   4. Division 26 - For lighting and electrical requirements for lit signage.
   5. Division 32 - Section "Pavement Markings", for fire lane, directional, and other pavement markings.

1.03 DELEGATED STRUCTURAL DESIGN FOR EXTERIOR SIGNAGE

A. Structural Criteria: Design signage and supports and attachments for signage, in compliance with wind and seismic loads, and within work stresses, as required by local codes and authorities having jurisdiction.
   1. Design for all surface mounted exterior signage, and attachments for all exterior signage, performed by a qualified engineer registered to perform such design in accordance with the requirements of local and state authorities for the project location.
   2. Where minimum gauges of sheet metal or other structural sizes or requirements are stated elsewhere in the specifications or Drawings, the most restrictive requirement shall prevail between the delegated design calculations; and the stated minimum requirements, thicknesses and sizes.
   3. Where support structure is provided by other trades, coordinate imposed loads from signage prior to preparation of shop drawings for each such supporting structural element or system. Promptly notify Architect of any conflicts or deficiencies.

1.04 SUBMITTALS

A. Submit shop drawings for all work for review prior to fabrication of materials. Shop drawings of individual letter signage shall indicate spacing. Shop drawings of all signage shall be drawn to scale, letter characters in type style specified and spacing shown exactly as sign is to be fabricated.
   1. Include signed delegated design statement of compliance with design criteria.

B. Submit samples of all colors for selection by Architect and materials proposed for use prior to fabrication.

C. Submit two product sample signs with pictogram, tactile characters, and Braille.
D. Submit sign schedule location key plan for all signage.

E. Sign schedule location key plan: Signage contractor shall submit a first draft sign schedule and location key plan for all signage in editable electronic format (excel preferred). Preliminary submittal shall indicate all proposed sign locations, types, and message copy. Architect will mark up the draft schedule and location plan. Make corrections and resubmit sign schedule and location plan until approved by Architect.
1. Signage contractor shall spell check all signage copy and inform Architect in the final sign schedule submittal to confirm suspected misspellings.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Materials properly protected and packaged so that no damage occurs during transit. Materials when delivered, protected by the Contractor against damage or theft.

1.06 QUALITY ASSURANCE

A. Signage shall meet government regulation for raised image signage and criteria of the Americans with Disabilities Act, and Texas Accessibility Standards (TAS).
1. Contractor shall be responsible for all TAS and local accessibility code signage requirements, regardless of whether they are specifically shown on the drawings or specified herein. Notify Architect of any conflicts or deficiencies. Any signage deficiencies noted by Authorities having Jurisdiction at the conclusion of the project shall be remedied by Contractor at no additional cost to the Owner.

1.07 WARRANTY

A. Fabricator’s Special Warranty: Manufacturer / Fabricator agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
1. Deterioration of finishes beyond normal weathering.
2. Deterioration of printed images.
3. Separation or delamination of sheet materials and components.
4. Failure of mechanical fasteners or components.
5. Separation of signs from substrates due to improper substrate preparation or due to inadequate strength or quantity of fasteners or adhesives.
   a. If defect is exhibited in a significant number of locations to indicate a systemic issue, corrections to attachments shall be made holistically to the type(s) of signs exhibiting the defect.
6. Warranty excludes damage due to vandalism or abuse.
7. Warranty Period: One years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Signage Design, General: Information on Drawings and as specified herein establish the design intent only, showing requirements for respective aesthetic effects and performance characteristics of signage but not necessarily all fabrication details required for complete sign installations.
1. Architect will provide a preliminary signage schedule, with all preliminary proposed copy. Signage contractor is responsible to translate into complete signage submittal package for Architect’s review and comment, and Owner approval.
2. Architect or Owner will provide electronic graphic files in vector format acceptable to signage fabricator for use in preparing all printed graphic images.
B. Font for Copy: Unless otherwise noted in Drawings or otherwise approved by Architect, provide TPWD font characters.
   1. Where or if individual characters conflict with handicap accessible code requirements, replace individual characters with similar appearance characters compliant with code requirements, or replace with similar appearance compliant font, as approved by Architect.

C. Accessibility Standards: Comply with accessibility standards indicated in References article. In the event of apparent conflict between Requirements and signage design indicated, notify Architect via submittal process and suggest corrections to design to maintain design intent and resolve the conflict. Coordinate with Architect to resolve conflicts in satisfactory manner.
   1. Architect’s review and approval of submittals is for general conformance with design intent and does not constitute review or approval of handicap accessible features.
   2. Signage fabricator is solely responsible to fabricate signs requiring accessible features in compliance with the provisions of applicable handicap accessibility codes. In event that non-compliant signage is installed and verified by authorities having jurisdiction as non-compliant, fabricator shall replace identified non-compliant signage with compliant signage of similar design, without additional cost to Owner.

2.02 MATERIALS

A. Materials, General: Materials and equipment as well as workmanship shall conform to the highest commercial standards available. Parts not identified specifically on Drawings shall be materials appropriate to job site conditions. All color changes made with sharp, clean even edges providing clear separation of sign copy.

B. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

D. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

E. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.03 MATERIALS - SPECIFIC

   1. Sign Size: 8"x8"or minimum size to accommodate requirements on sign with largest message.
   2. Sign Shape: Rectangular with square corners.
   3. Sign Materials:
      a. Face: Photopolymer face, in matte (non-glare) finish.
      b. Backing plate: Acrylic
      c. Exterior-entry Rooms: Where room signage is required for exterior-entry rooms, provide UV-Resistant, Exterior-Grade signage.
   4. Fabrication Options
      a. Tactile Graphics and Text:
1) Fabrication process: Provide tactile copy and grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer’s photopolymer bonded process. Sign face of single material, tactile characters and Braille integral to photopolymer. Adhesive-fixed characters are not acceptable.

2) Provide lettering and graphics precisely formed, uniformly opaque to comply with relevant ADA / TAS regulations and requirements indicated for size, style, spacing, content, position, and colors. Tactile characters to be raised min. 1/32" from surface. Computerized translation of sign copy to be responsibility of the manufacturer.

3) Provide signs with ADA / TAS compliant pictograms at restroom and locker room signs.
   b. Pictograms: Pictograms shall comply with recognized standards and locally enforced accessibility codes. Integrate verbal text descriptors and Braille below each raised pictogram, outside of the pictogram field.
      1) In addition to male/female pictograms, provide a "wheelchair" international handicap accessibility symbol on the signage for all accessible restrooms, bathing / shower rooms, and dressing / locker rooms.
   c. Mounting Panel Options:
      1) Size: Same size.
      2) Thickness: 0.080 inch thick matte finished acrylic.
   d. Background Appearance Options: Solid color as selected by Architect from manufacturer’s full custom color range.
   e. Tactile Lettering and Graphics Color Options: Selected by Architect from manufacturer’s full range of custom colors.
   f. Letter style and color: Selected by Architect from manufacturer's standard letter styles and color charts.
   g. Letter size and layout position: 1" high room identification letters, unless otherwise approved by Architect. In no case shall size be less than that required by handicap accessibility standards.

5. Installation Method
   a. Manufacturers recommended adhesive, or high strength clear vinyl tape.
   b. Where attachment is to glass sidelights, provide high strength clear vinyl tape attachment, with solid color blank backplate on reverse side matching sign color and size.

6. Fabrication - General
   a. General: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction. Sign fabricator is responsible to double check all requirements related to ADA and Texas Accessibility Standards requirements for accessible signs, in preparation of shop drawings and prior to sign fabrication. Signs fabricated that do not comply with these requirements shall be re-made in compliance with requirements at Fabricator's expense.
   b. Preassemble signs in the shop to the greatest extent possible to minimize field assembly. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view after final assembly.
   c. Conceal fasteners if possible; otherwise, locate fasteners to appear inconspicuous.
   d. Form panels to required size and shape. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.
   e. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
   f. Window Signs: Provide clear inserts panel for paper inserts at offices.
g. Exterior grade signs: Provide exterior grade signs where mounted outside of weather protective building enclosure.

B. Tactile Exit Signs: Provide signs to match design of interior room signage tactile exit signs with raised letters and Braille at rooms and corridors that serve as exit passageways and exit discharges, as required by local code, including any space that can be interpreted as an Exit Passageway and Exit Discharge. Size signs to match interior room identification signage, in same size and font text as handicapped accessible room signage. Colors as selected by Architect.
   1. Where there is room identification signage scheduled for the same door and the text and Braille message of the tactile exit sign will fit on the room identification signage below the room identification message, incorporate both signs into one sign.

C. Miscellaneous Handicap Accessibility Signage: Provide matching design of interior room identification signage mechanically mounted sign to match design of room identification signage, unless otherwise noted. Colors as selected by Architect.
   1. Directional Signage to Accessible Entries: Provide one of the following at each entrance door where not all entries to the building are handicap accessible:
      a. Exterior Directional Signage: At non-accessible entrances, provide exterior grade sign plaque with message to direct to the nearest accessible entrance.
         1) Mounting: Mechanically fasten to building wall near entry door. Provide sign with raised characters and Braille.
      b. Accessibility Symbol: At each accessible entrance, provide an international symbol of accessibility pictogram as follows:
         1) At glazed entry doors, provide 6" vinyl die-cut symbol, in color selected by Architect. Mount on glass adjacent to an accessible entry door, or where there is no sidelight, mount on door glass.

D. Street Address at Glazed Main Entry Doors: Provide 6" vinyl die-cut, four-digit number in color selected by Architect to be applied to glass adjacent to exterior main entrance doors.

E. Operation Hours at Glazed Entry Door: Provide 1" vinyl die-cut letters and numbers, in color "White", applied to exterior of main entrance door glass. Spacing between lines shall be 1/2" - 3/4". Confirm hours and wording with Architect and Owner before submitting layout.

F. Building Plaque: One 16” x 32” wide, Cast Aluminum Plaque, as manufactured by Southwell, O.M.C., A.R.K. Ramos, or approved equal. Each plaque is to be cast of aluminum and shall be free of pits and holes. Border and letters shall be raised, satin finish and background shall be oxidized, leatherette texture. Plaque shall be cleaned and lacquered. Border shall be “double line” edge with raised square profile border and lettering shall be Helvetica type style as selected by Architect from Manufacturer's available fonts. Mounting to be concealed anchors in substrate. Owner shall provide layout and copy requirements for each sign, and Architect and Owner shall approve rubbing prior to casting.

PART 3 - EXECUTION

3.01 EXAMINATION AND COORDINATION
   A. Coordinate mounting requirements for exterior substrates with other trades as required, including adequate strength and structural reinforcements where necessary.
   B. Coordinate with other trades as required for blocking in walls, electrical requirements, requirements for substrate preparation, and other requirements for signage installation as applicable.
   C. Examine installation areas to ensure that conditions are suitable for installation.
D. Examine existing conditions for construction or obstructions that prohibit signage to be installed in typical locations per TAS standards. Where location for TAS compliant mounting location is unclear, request clarification from Architect.

E. Examine signage for defects prior to installation. Do not install damaged signage.

F. Prepare shop drawings and schedule production of dedication plaque with adequate time for review, approval and fabrication to ensure the plaque will be installed at substantial completion, or other date as may be required for dedication ceremony.
   1. Submit initial shop drawings no later than 2 months, plus fabrication time, prior to scheduled substantial completion date, to ensure adequate time for Owner review and approval of dedication plaque.

3.02 PREPARATION

A. Verify mounting locations and types prior to fabrication. Coordinate exact locations with Architect where signs cannot be installed in typical location per Texas Accessibility Standards. Confirm where backplates etc. are needed for application to glass or similar substrates.

B. Fabricate signs according to approved shop drawings and sign schedule.

C. Clean mounting locations of dirt, dust, grease or similar conditions that would prevent proper installation. This signage contractor responsible to properly clean substrates so that signage may be properly applied.

3.03 INSTALLATION

A. Install products in accordance with suppliers' instructions, using mounting methods as specified and as recommended by sign manufacturer for best results.
   1. Mount with adhesive or high strength tape. Mount secure and tight to substrates.
   2. Mount with high strength double sided mounting tape, with backplates, at all signage applied to glass.

B. All signage and materials installed level, plumb, and true in spacing.

3.04 CLEANING, PROTECTION, AND REPAIR

A. Protect installed signage from damage and soiling due to construction operations.
   1. Install interior wall signage after substrates to receive painted finish have been painted, or if painting must be scheduled after initial sign installation mask off or remove and reinstall signs.

B. Remove adhesive, paint, or other spills and smears from sign surfaces, prior to inspection for substantial completion. Clean signs according to manufacturer's or fabricator's instructions. Do not use cleaners or methods that can damage sign surface or finish.

C. Remove any protective coatings at times as recommended by manufacturer or fabricator.

END OF SECTION 10 14 00
SECTION 10 26 133 - WALL AND CORNER PROTECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Work includes all labor, materials and services necessary to furnish and install all wall and corner guards as shown on drawings and as herein specified.

1.03 RELATED DOCUMENTS

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

B. Related Sections include the following:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to the work of this section.
   2. Division 7 Section: Sealants
   3. Division 9 Section: Gypsum Wallboard
   4. Division 9 Section: Ceramic Tiling, for Metal edge strips installed as corner guards or edge trimming.
   5. Division 9 Section: Painting

1.04 SUBMITTALS

A. Product Data: Submit product data, installation instructions and maintenance instructions.

B. Shop Drawings: Provide floor plan with proposed endwall guards, corner guard and wall guard locations as required by the contract documents for review. Show mounting heights and details.

C. Sample Selections: Provide samples of manufacturer's standard color range.

D. Verification Samples: Provide three 12” long minimum samples of each type, texture and color selected.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with project requirements, and Basis of Design product intent parameters, manufacturers that may offer specified items which may be incorporated in the Work include the following:
   1. Pawling Corporation, 32 Nelson Hill Road, Wassaic, NY 12592, 800-431-3456, sales@pawling.com
   2. Balco, 2626 S. Sheridan, Wichita, Kansas 67217, 800-767-0082, balcousa.com
   3. Construction Specialties (CS), Dallas 214-340-6400, Corp.800-233-8493, c-sgroup.com
   4. Impro Corporation (IPC), 580 W18766 Apollo Drive, Muskego, WI 53150, 800-222-5556, improcorp.com
2.02 CORNER GUARDS
A. Surface-Mounted Stainless Steel Corner Guards: Shall be Type CG-51 as manufactured by Pawling Corp. Acceptable manufacturer’s that may produce similar products include Balco, Constriction Specialties (CS), inpro corporation (IPC) and koroseal.
   1. Flame spread shall be 25 or less in accordance with ASTM E84.
   2. Stainless steel extrusions 16 gauge with 1/8” radius.
   3. Accessories: ADH-30 adhesive
   4. Type: Stainless Steel: #304 (Kitchen Grade) stainless steel, #4 satin finish.
   5. Height: As indicated on Drawings.

2.03 WALL END GUARDS
A. Surface-Mounted Stainless Steel Wall End Guards: Shall be inpro’s stainless steel end wall protector or approved equal. Acceptable manufacturer’s that may produce similar products include Balco, Constriction Specialties (CS), (IPC), koroseal and Pawling Corp..
   1. Flame spread shall be 25 or less in accordance with ASTM E84.
   2. Stainless steel extrusions 16 gauge with 1/8” radius.
   3. Accessories: ADH-30 adhesive
   4. Type: Stainless Steel: #304 (Kitchen Grade) stainless steel, #4 satin finish.
   5. Height: As indicated on Drawings.

PART 3 - EXECUTION
3.01 COORDINATION
A. Installation of corner guards shall be after painting is complete. If guard installation will precede painting, coordinate with painting trade as applicable to properly mask, protect, and clean corner guards to avoid damage to finishes.

3.02 INSTALLATION
A. Install at heights indicated on the drawings.
B. Install with top aligned as shown on drawings, unless otherwise directed by Architect. Where corner guard top elevation is not shown on drawings, corner guards shall be 42”, with bottom edge mounted at top of wall base.
C. Install wall and corner guards plumb, level and rigidly secure in place in accordance with manufacturer's instructions.

3.03 PROTECTION AND CLEANING
A. Protect finishes during construction by masking members with approved cardboard and paper as recommended by manufacturer.
B. Remove strippable plastic finish protection at time as recommended by Manufacturer. Do not allow plastic to melt onto surfaces.
C. Clean all exposed surfaces as recommenced by the manufacturer.

END OFSECTION 10 26 13
SECTION 10 28 13 - TOILET ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
   B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY
   A. Section Includes:
      1. Provide accessories as shown on the drawings and as herein specified.
   B. Related Sections include the following:
      1. Division 6 Section: Blocking in Stud Walls for Accessories

1.03 QUALITY ASSURANCE
   A. Model numbers listed for toilet accessories are items manufactured by Bobrick Corporation unless otherwise noted. Items as made by the Bradley Corp., American Specialties Co. Charles Parker Co. may be used provided materials meet performance and design requirements herein specified.
   B. All bathroom fixtures and accessories shall comply with all ADA federal, state and local Handicapped code requirements.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING
   A. Deliver items in manufacturer's unopened protective cartons. Maintain covers on units until installation is complete. Remove protective covers at final clean-up of installation.

1.05 SUBMITTALS
   A. Product Data: Submit manufacturer's technical data and installation instructions for each toilet accessory.

1.06 WARRANTY
   A. Electric Hand Dryer: Manufacturer’s 5-Year Limited Warranty.

PART 2 - PRODUCTS

2.01 ITEMS
   A. Soap Dispensers:
   B. Toilet Tissue Dispenser:
      1. Recess-mounted: Cabinet type satin stainless steel double roll holder, equal to Bobrick No. B-4288.
   C. Undersink Pipe Insulation: ADA compliant vinyl cover pipe insulation shall be TRUEBRO "Lav Guard 2", as manufactured by ISP Corp., in standard color, or approved equal.
D. Grab Bars: 1-1/2" diameter satin finish stainless steel grab bar sets with concealed fastenings. Bradley Series 832. Lengths and mounting configurations shall comply with all state and local Handicapped Accessibility code requirements.

E. Mirrors:
   1. Framed Wall Mirrors: No. 1 quality 1/4" float plate glass selected for silvering, electro-copper plated by galvanic process, surface-mounted mirror with stainless steel channel and filler strip on 1/8" non-abrasive polyethylene padding equal to Bobrick No. B-1656.

F. Hand Dryers: Mounting shall comply with ADA and all state and local handicapped accessibility code requirements.
   1. Surface mounted, equal to World Dryer “SLIMdri Hand Dryer”.
      a. Mounting: Surface mounted
      c. Electrical Requirements: As shown in Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All handicapped bathroom fixtures and toilet accessories shall comply with all federal, state and local Handicapped code requirements and comply with TAS (Texas Accessibility Standards) mounting locations and heights.

3.02 INSPECTION

A. Inspect blocking and plate inserts in framing to determine if material is in proper position for installation of accessories prior to wallboard surfacing being applied. Units securely attached to framing. Grab bars installed to withstand a 900 lb. loading condition; provide necessary concealed anchorage devices to meet load requirements.

END OF SECTION 10 28 13
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 DESCRIPTION OF WORK

A. Definition: "Fire extinguisher" as used in this section refers to units which can be hand-carried as opposed to those which are equipped with wheels or to fixed fire extinguishing systems.

B. Types of products required include:
   1. Fire extinguishers.
   2. Fire extinguisher cabinets.
   3. Fire extinguisher brackets.
   4. Automated Defibrillators (AED), alarm system, and cabinets.
   5. Wall signs for fire extinguishers and AED cabinets.

C. Related Sections include the following:
   1. Division 06 - Section "Rough Carpentry", for coordination of blocking in walls.
   2. Division 07 - Section "Joint Sealants".

1.03 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain products in this section from one manufacturer.

B. UL-Listed Products: Provide new portable fire extinguishers which are UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher indicated.

1.04 SUBMITTALS

A. Submittal shall include manufacturer's product literature, both pictorial and written.

PART 2 - PRODUCTS

2.01 PORTABLE TYPE FIRE EXTINGUISHERS

A. Manufacturers: Design is based on products as manufactured by Activar / J.L. Industries, Inc. or Larsen's Manufacturing Co. Subject to compliance with requirements, provide the named products, or approved equal by another manufacturer.

B. Multi-purpose Class ABC Fire Extinguishers: Provide all extinguisher cabinets with ABC type extinguishers unless otherwise noted. ABC Fire extinguishers shall be a multi-purpose dry chemical type, enameled metal containers with pressure indicating gauges, rated for Class A, B, and C fires.
   1. At Fire Extinguisher Cabinets, provide 10 lb extinguishers, 4A-80BC rated, equal to the following:
      a. J. L. Industries Model Cosmic 10E.
   2. At Break Room and Electrical Room, provide 5 lb extinguishers mounted on brackets, 3A-40BC rated, equal to the following:
a. J.L. Industries Model Cosmic 5E, with MB818 bracket at Break Room (non-storage applications).
b. Larsen's Model MP5-A with nozzle, with standard bracket in electrical room.

3. Where locations for specified extinguishers are not indicated in Drawings, confirm exact locations with Architect.

C. Fire Extinguisher Cabinets: Provide semi-recessed, one-piece steel cabinet with stainless steel finish with rolled-edge trim. Semi-recessed cabinets shall not project more than 4" from face of wall, and overall depth sized to fit specified fire extinguishers. Provide recessed handle where 4" projection of the cabinet is required. Top of rough opening for unit shall be at 54" above finished floor surface, unless otherwise dictated by governing authority. Cabinets shall be J.L. Industries Cosmopolitan series, Larsen's Architectural series, or approved equal.

1. Semi-recessed at typical stud construction: Designed to recess into 3-5/8" stud wall construction (nominal 4" recessed).
2. Finish: Stainless Steel.
3. Door Style: Vertical Duo (tall, narrow light).

D. Automated Defibrillator Device (AED) Cabinets: One-piece steel cabinet with clear acrylic full glazed door. J.L. Industries' 1400 Series AED Cabinets, or approved equal. AED Cabinets are to be configured with battery power source alarm. Install with initial battery. Top of rough opening for unit shall be at 4'-0" A.F.F., unless otherwise dictated by governing authority.

1. Cabinet Frame and Door Finish: Stainless Steel cold rolled steel with white powder coat finish.
3. Lock: None.
4. Decal: Standard red AED with graphic symbol, applied to light.
5. J. L. Industries 1400 Series LifeStart AED Cabinet or approved equal.
6. AED Device: "Lifepak" LP-CR PLUS Defibrillator with starter kit for reduced energy infant and child electrodes.

E. Wall Signs:
1. Provide wall signs above fire extinguishers, equal to J.L. Industries 4"x12" flush plastic fire extinguisher sign #25S. Mount bottom of sign at 7'-6" unless otherwise indicated.
2. Provide AED wall sign at each AED, equal to J.L. Industries 8"x11" flat plastic wall sign, model 14S. Mount signs centered 12" above AEDs unless otherwise indicated.

F. Anchors: Provide non-corrosive types as required by wall conditions.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install items included in this section in location and at mounting height indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities as directed by local fire marshal.

B. Securely fasten mounting brackets to structure, square and plumb, to comply with manufacturer’s instructions.

C. Remove protective plastic sheets prior to Architect’s inspection for substantial completion.

END OF SECTION 10 40 00
PART 1  GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aluminum flagpole, ground set.
   2. Concrete base.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 03 30 53 - Landscape Cast-In-Place Concrete.
   3. Section 07 92 05 - Landscape Joint Sealers.

1.2 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Design flagpole and anchorage devices in accordance with ANSI/NAAMM FP 100197.
   2. Minimum design wind speed: 112 MPH with 6 x 9 foot flag.

B. Pole Description:
   1. Type: Ground set, vertical, fixed.
   2. Pole: Cone tapered.
   3. Dimensions:
      a. Exposed height: 30'-0".
      b. Overall height: 33'-0".
      c. Top diameter: 3.0 inches.
      d. Butt diameter: 5.0 inches.
      e. Wall thickness: 0.156 inch.
      f. Ball diameter: 5.0 inches.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Include pole and base dimensions, materials, finishes, and accessories.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 2 years experience in work of this Section.

1.5 DELIVERY, STORAGE AND HANDLING

A. Handle products in accordance with AAMA CW-10.

B. Wrap poles in heavy paper to prevent damage during shipping and handling.
PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. American Flagpole. (www.aflag.com)
   2. Concord American Flagpole. (www.concordamericanflagpole.com)
   3. Ewing International. (www.ewingflagpole.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS


B. Concrete: Specified in Section 03 30 53.

2.3 COMPONENTS

A. Pole: Seamless aluminum pipe.

B. Fittings:
   1. Ball: Spun aluminum.
   2. Truck: Revolving, non fouling, cast aluminum.
   3. Halyard: Internal type, stainless steel aircraft cable with two stainless steel swivel snap hooks.
   4. Winch: Internally mounted, with removable crank handle and automatic brake allowing flag to be set at any position, with counterweight and beaded retainer ring.
   5. Door: Flush with compression lock. Key locks alike; furnish four keys.
   6. Collar: Cast aluminum, minimum 1 inch larger in diameter than foundation sleeve.
   7. Foundation sleeve: 16 gage, 10 inch diameter, galvanized, corrugated steel with 3/8 inch base plate. Provide minimum 12 inch long lightning rod with setting plate and one set each steel and hardwood centering wedges.

2.4 ACCESSORIES

A. Grout: Cement based, non shrink.

B. Joint Sealer: Specified in Section 07 92 05.

2.5 FINISHES

A. Aluminum: AAMA 611, Architectural Class I anodized to 0.0007 inch minimum thickness, dark bronze color.

B. Apply bituminous coating to that part of flagpole to be set in base, inside and out.
PART 3 EXECUTION

3.1 INSTALLATION

A. Install flagpoles and accessories in accordance with manufacturer’s instructions and approved Shop Drawings.

B. Install foundation sleeve in concrete footing.

C. Center pole in sleeve using steel wedges; plumb with hardwood wedges. Fill sleeve with clean, dry sand; top off with grout.

D. Install collar to conceal sleeve.

E. Apply joint sealer around pole at top of grout and collar.

F. Electrically ground flagpole installation.

3.2 ADJUSTING

A. Touch up minor scratches and abrasions to match original finish.

END OF SECTION 10 75 00
SECTION 11 31 00 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY
A. Section Includes:
   1. Furnish and install residential appliances as specified herein.
   2. Coordinate appliance dimensions and operating clearances with millwork.
B. Related Sections include the following:
   1. Division 6 Section “Interior Architectural Woodwork”
   2. Division 22 Section “Plumbing”
   3. Division 23 Section “Mechanical”
   4. Division 26 Section “Electrical”

1.03 QUALITY ASSURANCE
A. Provide residential equipment which complies with standards and bears certification labels as follows:
   1. Provide residential equipment with U. L. labels.
B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to the following: General Electric Co, Frigidaire Co.; Hotpoint Division, General Electric Co.; Tappan Division, Tappan Appliances, Whirlpool Corporation, Kenmore, InSinkErator, Imperial, Manitowoc, Empire, and/or Ducane Products Co..

1.04 PRODUCT STORAGE, DELIVERY AND HANDLING
A. Deliver products to project site in manufacturer's undamaged protective containers after spaces to receive them have been fully closed.

1.05 SUBMITTALS
A. Submit manufacturer's specifications and installation instructions for each type of appliance, including data indicating compliance with requirements. Submit operating and maintenance instructions for each item of residential equipment.
B. Submit schedule of appliance, using same unit and building designations shown on drawings.
C. Shop Drawings: For range exhaust hood. Include plans, elevations, sections, roughing-in dimensions, fabrication details, utility service requirements, and attachments to other work.

1.06 WARRANTY
A. Submit manufacturer's standard written warranty for each item of residential equipment.

1.07 COORDINATION
A. Coordinate with other trades by providing requirements for proper installation.

PART 2 - PRODUCTS

2.01 ITEMS TO BE PROVIDED

A. Refrigerator: GE Profile™ Series ENERGY STAR® 27.7 Cu. Ft. Fingerprint Resistant French-Door Refrigerator with Hands-Free AutoFill. Model #: PFE28KYNFS or approved equal.

B. Microwave Oven: GE Profile™ 2.2 Cu. Ft. Countertop Sensor Microwave Oven, Model #: PES7227SLSS or approved equal.

C. Garbage Disposal: As scheduled in Plumbing Drawings.

2.02 FINISH

A. Provide manufacturer's stainless steel or as specified by Architect.

PART 3 - EXECUTION

3.01 COORDINATION

A. Fully coordinate with other trades all requirements for proper installation. Coordination includes, but is not limited to, the following:
   1. Utility rough-ins, including type, sizing, connections, and required locations.
   2. Templates: Provide templates or other information as required for other trades to coordinate with approved equipment. Submit equipment and appliances submittal in time for review and approval as required to avoid impact to production schedules of other affected trades.
   3. Millwork: Fully coordinate all dimensions required to avoid conflicts between door and drawers and cabinet handles at inside cabinet corners and similar conditions that might affect function or ability to fully open doors and drawers, either on the millwork or the appliance / equipment. Fully coordinate clear dimensions required for appliances and equipment mounted in or adjacent to millwork to fit neatly, with required clearances and tolerances, and without sight gaps.
      a. Perform all such coordination prior to preparation of millwork shop drawings.
   4. Freestanding Equipment: Verify that clearances to as-constructed conditions are adequate to properly access and operate equipment.
   5. Confirm exact location for microwave and owner provided coffee maker and their connections with Owner in field.

B. Contractor shall not be due additional compensation to make modifications to rough-ins, millwork, clearances / dimensions, and similar conditions that may be required for satisfactory installation, that must be corrected due to Contractor’s failure to coordinate between trades.

3.02 INSTALLATION, GENERAL

A. General: Comply with manufacturer's instructions and recommendations.

B. Verify that accessory items required have been furnished.

C. Locate and install items as indicated in Drawings and to conceal utility attachments to the maximum extent possible.

D. Securely anchor units to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
E. Built-in Equipment: Securely anchor units to supporting cabinets, countertops, or other adjacent construction as applicable, with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

F. Freestanding Equipment: Place units in final locations after finishes have been completed in each area.

G. Utilities: Refer to Divisions 22, 23 and 26 for plumbing, mechanical, and electrical requirements.

3.03 ADJUST AND CLEAN

A. Test each item of equipment to verify proper operation. Make necessary adjustments.

B. Verify that accessory items required have been furnished.

C. Remove packing material from equipment items and leave units in clean condition, ready for operation.

D. Retain Manufacturers' installation instructions and owner manuals, including for any Owner-Provided equipment installed by Contractor, for incorporation into the Operations and Maintenance Manuals.

E. Clean appliances and equipment prior to substantial completion, using materials and methods recommended by the Manufacturer of each item, and that will not damage items or finishes.

END OF SECTION 11 31 00
SECTION 11 52 20 - TELEVISION ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Television mounting accessories, as shown on the drawings and as herein specified.

B. Related Sections include the following:
   1. Division 6 Section - Rough Carpentry for wall blocking.

1.03 QUALITY ASSURANCE

A. Acceptable Manufacturers: Sanus Co., Eden Prairie, MN (800) 359-5520, or equal by Chief Co.

1.04 SUBMITTALS

A. Shop drawings, manufacturer's standard brochures and details based on the contract documents submitted to the architect for review and approval.

PART 2 - PRODUCTS

2.01 ITEMS

A. Television Wall-Mount Bracket: Full Motion wall-mount bracket capable of supporting 150 lbs., and constructed of extruded aluminum wall plate construction, equal to Sanus Model No. VLF628 “Universal Mounting”. Bracket to be capable of post-installation height and leveling adjustment. Shall fit televisions from 46" to 90".

PART 3 - EXECUTION

3.01 INSPECTION

A. Contractor to examine mounting and operation prior to installation. Verify site conditions prior to installation. Field measurements must be verified.

3.02 INSTALLATION

A. Materials installed level, plumb, straight and true to line. Operable mechanisms properly adjusted.

B. Contractor shall install and coordinate locations for mounting brackets with Architect.

END OF SECTION 11 52 20
SECTION 12 24 00 - MOTORIZED & MANUAL ROLLER SHADES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY
A. This section includes integrated motor control options for the following:
   1. Manual Roller Solar Shades
B. Related Sections include the following:
   1. Division 6 Section “Rough Carpentry” for window shade bracket support blocking or pocket assemblies.
   2. Division 26 Section “Electrical” for installation of electrical motor control systems.

1.03 PERFORMANCE REQUIREMENTS
A. Fire: Provide shade fabrics tested in accordance with:
   1. 1989 NFPA 701 small scale Vertical Burn Test and rated “PASS”
   2. 1996 NFPA 701 small scale Vertical Burn (telephone booth test) and rated “PASS”
B. Toxicity: Provide shade fabrics tested in accordance with University of Pittsburgh Toxicity Protocol including LC50 analysis and toxicity characteristics.
C. Anti-microbial:
   1. ASTM G-22-80 results for ATCC6538 (Staphylococcus aureus) an ATCC13388 (Pseudomonas aeruginosa) indicating minimum 5mm (0.197 inches) “No Growth Contact Area”.
   2. ASTM G-21-85 results for ATCC9642, ATCC9348 and ATCC9645 indicating “No Growth”.
D. Electrical: Integrated motor control systems and components approved AS A SYSTEM by either Underwriter Laboratories (UL) or Electronic Testing Laboratories (ETL).
E. Compliance with safety regulations including ANSI/WCMA A100.1

1.04 SUBMITTALS
A. Specification Conformance Document: Indicate whether the submitted equipment deviates from the specific requirements:
   1. Address or itemize compliance, or detail the alternate means submitted and indicate specific methodology used for Architect review & approval.
B. Product Data: Manufacturer's data sheets with performance specifications demonstrating compliance with specified requirements, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Submit manufacturer’s descriptive literature and details for each product type specified. Details indicate materials, finishes, construction, and dimensions of individual components, profiles, and mounting requirements.
4. Submit wiring diagrams, details on integration to lighting control systems, AV systems, and building management systems, installation instructions, and operating instructions.
5. Submit current certificates demonstrating all line voltage components of the system are either UL Listed or UL recognized. All low voltage components within the system shall be powered by UL listed transformer or UL recognized class 2 transformers or power supplies and wired as NEC Class 2 circuits.

C. Shop Drawings; include:
   1. Provide head, jamb and sill details, and relevant dimensions for mounting requirements for each product type and mounting condition.
   2. Provide shade schedule indicating room number, opening size(s), quantities and key to details.
   3. Provide one-line wiring system diagrams including connection details and overall arrangement of shades and control locations supplied by this section for installation and connection under division 26.

D. Selection Samples: For each finish product specified provide:
   1. Portfolio of shade fabric swatches for initial fabric color selection from manufacturer’s full range of available fabrics.
   2. Material samples for color and finish selection of controls.

E. Verification Samples: For each finish product specified:
   1. One fully operational window shade sample of each type required complete with selected shade fabric including sample of seam / batten when applicable. Location of sample as directed by Architect.
   2. One complete set of all shade components demonstrating compliance with project requirements when applicable.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. The responsibility for the design, engineering, installation, and performance of motorized window shade systems specified will be assigned to a single manufacturer and their qualified dealers/installers.
   2. Minimum 5 years experience in manufacture of precision-engineered, low-voltage motorized shading systems.
   3. Furnish shading system and electrical control equipment for a complete installation and single source responsibility of shading and lighting control where applicable.
   4. The manufacturer, subsidiary, or licensed agent will be qualified to supply the products specified and to honor any claims against the product presented in accordance with the warranty.
   5. Provide 24-Hour / 7-Day technical support to troubleshoot system wiring and aid in system programming.

B. Installer Qualifications: Installer shall be qualified to install and commission the specified products by prior factory training, experience, demonstrated performance, and acceptance of any requirement of the manufacturer, subsidiary of the manufacturer, or licensed agent.

C. Do not fabricate shades without obtaining field dimensions for each opening. Coordinate construction of surrounding conditions to allow for timely field dimension verification.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver items to the project until all plaster, painting and other wet work has been completed and is dry.
B. Deliver shades to project in labeled protective packaging, uniquely labeled to identify each shade for each opening. Schedule delivery to prevent delays to completion of work but to minimize on-site storage time.

C. Store materials in a dry, secure place. Protect from weather, surface contaminants, corrosion, construction traffic and all other potential damage.

### 1.07 PROJECT CONDITIONS

A. Maintain environmental conditions within recommended limits:
   1. Ambient operating temperature: 32–72 °F
   2. Humidity: 0–90%, non-condensing.
   3. Do not install products under environmental conditions outside manufacturer's absolute limits.
   4. Products are intended for Indoor use only.

B. Shade system shall not be installed until the building is operating at ambient temperature and humidity ranges that are consistent with those intended for eventual building occupancy & use.

### 1.08 COORDINATION

A. Contractor shall coordinate installation of the following items with the window shade contractor:

B. Contractor shall provide the following materials and services to the window shade contractor for electrically powered window treatments:
   1. Power wiring in accordance with requirements provided by the window shade contractor or electrical contractor.
   2. Low-voltage wiring as necessary for operation of shade control system with requirements provided by the window shade or electrical contractor.

C. Scheduling:
   1. Fabricate shades after obtaining field dimensions for each opening.
   2. Coordinate construction of surrounding conditions to allow for timely field dimension verification.
   3. Manufacturer’s standard lead times apply. Reference submittal and schedule accordingly for project timeline.

### 1.09 WARRANTY

A. Shade motors and motor control system electrical components: Provide manufacturer’s Warranty under provisions of Division 1 Section "General Requirements". Warranty period shall be 8 years (limited, pro-rated) from Date of Substantial Completion, and 2 years (full, 100%) for all components. Warranty period shall include all operating parts.

B. Shadecloth and all other components of shade system are Warranted to be fit for the use intended for a minimum of 5 years.

C. In the event of a warranted product failure, the Shade Contractor will, at no cost to Owner, facilitate acquisition and delivery of all necessary components to the Owner.

### PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Basis of design: Quality, design, and desired function are based on "Mecho 5" manual products by MechoSystems, Long Island City, NY (718) 729-2020.
   1. Finish color as selected by Architect from Manufacturer's standard range of colors.
B. Substitutions: Under provisions of Division 1.
   1. All proposed substitutions must be clearly delineated, and must be submitted in writing for approval by Architect a minimum of 10 working days prior to the bid date, and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.

2.02 APPLICATION/SCOPE
   A. Roller Shade Schedule
      1. Shade Type: Manual Shade shall be "Mecho 5" with LAM (Lift Assist Mechanism).

2.03 SYSTEM REQUIREMENTS
   A. Aesthetics
      1. Symmetrical light gaps of no more than 0.75 inch typical or 0.625 inch minimum.
      2. Shade mounting position can be adjusted while the shade is installed to ensure perfect shade centering.

2.04 SHADE BANDS
   A. Mounting:
      1. Wall-mounted with fascia cover and end caps. Provide continuous fascia - no splices.
      2. Roller shade brackets provide symmetrical light gaps of 0.25 inch on each side of shade.
      3. Mount shades center-to-center over window jambs.
   B. Shade Bands: Construction of shade band includes the fabric, the enclosed hem weight, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.
      1. Concealed Hembar: Shall be continuous extruded aluminum for entire width of shade band and with the following characteristics:
         a. Hembar shall be heat sealed on all sides.
         b. Open ends shall not be accepted.
      2. Shade Band and Shade Roller Attachment:
         a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection.
         b. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a “snap-on” snap-off” spline mounting, without having to remove shade roller from shade brackets.
         c. Mounting Spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
         d. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets, does not meet the performance requirements of this specification and shall not be accepted.

2.05 ROLLER SHADE FABRICATION
   A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.
   B. Fabricate shade cloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch in either direction per 8 feet of shade height due to warp distortion or weave design.
      1. Concealed hem bar typical.
      2. Exposed light seal hem bar with light seal jamb channels for blackout shades.
2.06 ROLLER SHADE COMPONENTS

A. Access and Material Requirements:
   1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
   2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.

B. Manual Operated Chain Drive Hardware and Brackets:
   1. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
   2. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.
   3. Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.
   4. Provide shade hardware system that allows for operation of multiple shade bands (multi-banded shades) by a single chain operator, subject to manufacturer’s design criteria. Connectors shall be offset to assure alignment from the first to the last shade band.
   5. Provide shade hardware system that allows multi-banded manually operated shades to be capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degrees total offset.
   6. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable.
   7. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel or heavier as required to support 150 percent of the full weight of each shade.

C. Drive Bracket / Brake Assembly:
   a. MechoShade Drive Bracket model M5 shall be fully integrated with all MechoShade accessories, including, but not limited to: SnapLoc fascia, room darkening side / sill channels, center supports and connectors for multi-banded shades.
   b. M5 drive sprocket and brake assembly shall rotate and be supported on a welded 3/8 inch (9.525 mm) steel pin.
   c. The brake shall be an over running clutch design which disengages to 90 percent during the raising and lowering of a shade. The brake shall withstand a pull force of 50 lbs. (22 kg) in the stopped position.
   d. The braking mechanism shall be applied to an oil-impregnated hub on to which the brake system is mounted. The oil impregnated hub design includes an articulated brake assembly, which assures a smooth, non-jerky operation in raising and lowering the shades. The assembly shall be permanently lubricated. Products that require externally applied lubrication and or not permanently lubricated are not acceptable.
   e. The entire M5 assembly shall be fully mounted on the steel support bracket, and fully independent of the shade tube assembly, which may be removed and reinstalled without effecting the roller shade limit adjustments.

9. Drive Chain: #10 qualified stainless steel chain rated to 90 lb. (41 kg) minimum breaking strength. Nickel plate chain shall not be accepted.
   a. Provide upgraded optional jamb mount chain retainers, except provide no retainers at storefront window walls (in Dining/Dayroom and Fitness).

C. Interfaces:
   1. Interface via Contact Closure Inputs.
   2. Interface with Lutron Grafik Eye System.
2.07 ROLLER SHADE SCHEDULE
A. Roller Shade Schedule: Refer to the Drawings for locations.
   1. Manual operating, chain drive, sunscreen roller shades in all other locations.
      a. With recessed shade pockets with bottom closures, and with closure mounts as
         required, shades fully recessed into ceilings or bulkhead.

2.08 SHADECLOTH
A. Solar Sunscreen Shadecloth: “Thermoveil Basket Weave” Series:
   1. Basketweave pattern, 5 percent open.
   2. Color: Silver Birch

2.09 ROLLER SHADE ACCESSORIES
A. Shade Pocket: For recessed mounting in acoustical tile or drywall ceilings as indicated on the
   drawings.
   1. Either extruded aluminum and or formed steel shade pocket, sized to accommodate
      roller shades, with exposed extruded aluminum closure mount, tile support and
      removable closure panel to provide access to shades.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Begin installation after substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of
   unsatisfactory preparation before proceeding.

3.02 PREPARATION
A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by manufacturer for achieving the best
   result for the substrate under the project conditions.

3.03 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Install shades in windows level and plumb to provide smooth operation.
C. Install in accordance with manufacturer’s product data and approved shop drawings.
D. A factory-qualified technician shall perform field measurement and installation.

3.04 ADJUSTING
A. Adjust the level, projection, and shade centering directly from mounting bracket.
B. Adjust fabric on tube if visibly telescoping.
C. Adjust lift assist mechanisms for smooth operation and so that shades do not feel “too heavy”
   in the force required on the chain to raise shades.

3.05 CLEANING
A. Touch up damaged finishes and repair minor damage in order to eliminate evidence of repair.
   Remove and replace work that cannot be satisfactorily repaired.
B. Clean exposed surfaces, including metal and shade fabric, using non-abrasive materials and methods recommended by the shade fabric manufacturer. Remove and replace work that cannot be satisfactorily cleaned.

3.06 DEMONSTRATION
A. Demonstrate operation method and instruct owner's personnel in the proper operation and maintenance of the window shade systems.
B. Manufacturer’s Instructions:
   1. Installation, Programming, and Maintenance instructions to be included in product packaging.
   2. 24-Hour / 7-Day Factory Technical Support shall be available to aid with unforeseen installation difficulties.

3.07 PROTECTION
A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 12 24 00
PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings.
   3. Mechanical sleeve seals.
   4. Sleeves.
   5. Grout.
   7. Demonstration.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including “Uniform General Conditions for State of Texas Construction Contracts Including Supplementary General Conditions for Projects Administered by the Texas Parks and Wildlife Department” apply to this Section.

1.03 RELATED SECTIONS

A. Section 221116 Domestic Water Piping.

B. Section 221316 Sanitary Waste and Vent Piping.

C. Section 221319 Sanitary Waste and Vent Specialties.

1.04 DEFINITIONS

A. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. The following are industry abbreviations for plastic materials:
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic.
C. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.05 SUBMITTALS

A. Product Data:
   1. Transition fittings.
   2. Mechanical sleeve seals.

B. Additional Submittals:
   1. Provide submittals for every item on the plumbing schedule, all piping, accessories, hangers, etc.

C. Shop Drawings: Shop drawings for plumbing piping systems including the following component.
   1. Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.
   2. For electric heating cable. Include plans, sections, details, and attachments to other work. Wiring Diagrams: Power, signal, and control wiring.
   3. Locations of Domestic Water Piping Specialties and valves within domestic water and domestic hot water supply systems
   4. Water heater and plumbing fixture connections.
   5. Locations and elevations of sanitary waste and vent specialties.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

1.08 AS-BUILT DRAWINGS

A. Definitions
   1. Contractor Markups – Drawings that are marked and annotated to show the project As-Built and constructed by the contractor. They are part of the working as-built set.
2. As-Built Drawings – The amended “As-designed” drawing revised to show the project as the contractor built and constructed it. The revisions from Contractor Markups and field inspection notes are transferred to the Final as-built set of drawings. The final as-built drawings include modifications during construction, field requested changes, shop drawing modifications, and contractor designs,

B. Description of Work

Section includes: Administrative and procedural requirements for as-built process for contractor to follow.

C. Record Document Submittals: Refer to TPWD for specific requirements.

Record As-Built Drawings: General Contractor shall maintain on-site as-built Contract Drawings, in Contractor Field Office.

a. Changes to Drawings, including those that involve only narrative, shall be clearly and neatly marked in red pen or pencil, and shall be noted on appropriate drawings. Changes to the Contract Drawings include:
   1) Changes to material or equipment for substitutions approved through the Architect/Engineer’s submittal process.
   2) Where contract drawings or specifications show options or alternates, only the option selected for construction shall be shown on the final as-built prints. Cross out such words and phrases as “approved equal” and list specifically the material provided.
   3) Shop drawing information.
   4) RFI’s and Change Order information.
   5) Changes made by the Inspector to accommodate field conditions.
   6) Actual location, kinds and sizes of all existing and new utility lines, especially underground lines within the construction area. Measurements shall be shown for all change of direction points and all surface or underground components such as valves, manholes, drop inlets, clean outs, meters, etc.
   7) Changes in location of equipment and architectural features.
   8) All construction changes that result from the final inspection.

b. General Contractor shall note each entry with a notation referencing source of information (Example: RFI #94, CO #3, or field notes of same).

D. Mark-Up Guideline

The following information is provided to improve the quality of the marked-up prints and thereby facilitate preparation of final as-built drawings. The most important guideline is that the marked-up changes on the prints shall be complete and understandable.

1. Frequently use written explanation on As-Built drawings to describe changes. Do not rely totally on graphic means to convey the revision.
2. Legibility of lettering and digit values shall be clean and clear and readable from a scanned copy.
3. Whenever a revision is made, make changes to affect related section views, details, legend, plans and elevation view, schedules, notes and call-out designations, and mark accordingly to avoid conflicting data on all other sheets.
4. When changes are required on small-scale drawings or on drawings with limited area available, large-scale inserts shall be drawn or sketched, with leaders to the location where applicable.
5. When attached prints (or sketches) are provided with marked-up print, indicate whether:
   a. Entire drawing shall be added to contract drawings or
   b. Whether the contract drawings shall be changed to agree, or
   c. For reference only to further details not required for initial design.
6. Make the comments on the drawing complete without reference to letters, memo’s or materials that are not also a part of the As-Built. For instance, do not just say, “As per Change Order #12”, when the actual change order states, “Changed water pipe from 2-1/2” to 3”. This also applies for changes as per the Architect/Engineer, Owner or Inspector.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

2.03 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
D. Solvent Cements for Joining Plastic Piping:
1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

E. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.04 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Available Manufacturers:
   b. Dresser Industries, Inc.; DMD Div.
   c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
   d. JCM Industries.
   e. Smith-Blair, Inc.
   f. Viking Johnson.
   g. Or approved equal.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.


B. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Available Manufacturers:
   b. Fernco, Inc.
   d. Plastic Oddities, Inc.
   e. Or approved equal.

2.05 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
   e. Or approved equal.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.06 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.
E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.07 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Sleeves are not required for core-drilled holes.

M. Permanent sleeves are not required for holes formed by removable PE sleeves.

N. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
      b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
      c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend
sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Nonpressure Piping: Join according to ASTM D 2855.

D. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

E. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.03 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.

B. Install equipment to allow right of way for piping installed at required slope.
3.04 GROUTING

A. Mix and install grout for plumbing equipment base plates and anchors.
B. Clean surfaces that will come into contact with grout.
C. Provide forms as required for placement of grout.
D. Avoid air entrapment during placement of grout.
E. Place grout, completely filling equipment bases.
F. Place grout on concrete bases and provide smooth bearing surface for equipment.
G. Place grout around anchors.
H. Cure placed grout.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain equipment installed in this project. Video record the training sessions or provide manufacturer’s standard maintenance Video disk.

3.06 O & M MANUAL

A. Contractor shall provide an Operation and Maintenance Manual for the Owner. Every item in the equipment schedule shall be included in the manual. The manual shall include the equipment schedule, submittal data for items installed, parts lists, maintenance schedule, operational instructions and phone number(s) of local representative for the item.

END OF SECTION 22 0500
**SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

A. Section Includes:
   1. Thermometers.
   2. Gages.
   3. Test plugs.

**1.02 RELATED DOCUMENTS**

A. Drawings and general provisions of the Contract, including “Uniform General Conditions for State of Texas Construction Contracts Including Supplementary General Conditions for Projects Administered by the Texas Parks and Wildlife Department” apply to this Section.

**1.03 RELATED SECTIONS**

A. Section 220500 Common Work Results For Plumbing.
B. Section 221116 Domestic Water Piping.
C. Section 223300 Electric Domestic Water Heaters.

**1.04 DEFINITIONS**

A. CR: Chlorosulfonated polyethylene synthetic rubber.
B. EPDM: Ethylene-propylene-diene terpolymer rubber.

**1.05 SUBMITTALS**

A. Product Data: For each type of product indicated; include performance curves.
B. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.
C. Product Certificates: For each type of thermometer and gage, signed by product manufacturer.
PART 2 - PRODUCTS

2.01 DIRECT-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   2. Trerice, H. O. Co.
   3. Weiss Instruments, Inc.
   4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
   5. Or approved equal.

B. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter.

C. Element: Bourdon tube or other type of pressure element.

D. Movement: Mechanical, connecting element and pointer.

E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Pointer: Red metal.

G. Window: Glass or plastic.

H. Ring: Metal or plastic.

I. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

J. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.02 REMOTE-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   1. AMETEK, Inc.; U.S. Gauge Div.
3. Marsh Bellofram.
4. Miljoco Corp.
5. Palmer - Wahl Instruments Inc.
6. REO TEMP Instrument Corporation.
7. Tel-Tru Manufacturing Company.
8. Trerice, H. O. Co.
9. Weiss Instruments, Inc.
10. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
12. Or approved equal.

C. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter with holes for panel mounting.

D. Element: Bourdon tube or other type of pressure element.

E. Movement: Mechanical, connecting element and pointer.

F. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

G. Pointer: Red metal.

H. Window: Glass or plastic.

I. Ring: Brass.

J. Connector: Bottom or Back union type.

K. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

L. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.03 BIMETALLIC-ACTUATED DIAL THERMOMETERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   2. Ernst Gage Co.
   3. Eugene Ernst Products Co.
   5. Miljoco Corp.
   6. NANMAC Corporation.
   7. Noshok, Inc.
   8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.
16. Or approved equal.

B. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.

C. Case: Dry type, stainless steel with 5-inch diameter.

D. Element: Bimetal coil.

E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Pointer: Red metal.

G. Window: Glass or plastic.

H. Ring: Stainless steel.

I. Connector: Adjustable angle type.

J. Stem: Metal, for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.04 THERMOWELLS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   1. AMETEK, Inc.; U.S. Gauge Div.
   3. Ernst Gage Co.
   5. Miljoco Corp.
   6. NANMAC Corporation.
   7. Noshok, Inc.
   8. Palmer - Wahl Instruments Inc.
   9. REO TEMP Instrument Corporation.
  10. Tel-Tru Manufacturing Company.
  11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.
16. Or approved equal.

B. Manufacturers: Same as manufacturer of thermometer being used.

C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.05 PRESSURE GAGES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   1. AMETEK, Inc.; U.S. Gauge Div.
   3. Ernst Gage Co.
   4. Eugene Ernst Products Co.
   5. KOBOLD Instruments, Inc.
   7. Miljoco Corp.
   8. Noshok, Inc.
  10. REO TEMP Instrument Corporation.
  11. Trierice, H. O. Co.
  12. Weiss Instruments, Inc.
  13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
  14. WIKA Instrument Corporation.
  15. Winters Instruments.
  16. Or approved equal.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
   1. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter.
   2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
   3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
   4. Movement: Mechanical, with link to pressure element and connection to pointer.
   7. Window: Glass or plastic.
   8. Ring: Brass.
   9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
  10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
  11. Range for Fluids under Pressure: Two times operating pressure.
C. Remote-Mounting, Dial-Type Pressure Gages: ASME B40.100, indicating-dial type.
1. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter with holes for panel mounting.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Window: Glass or plastic.
8. Ring: Brass.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

D. Pressure-Gage Fittings:
1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.06 TEST PLUGS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Flow Design, Inc.
2. Peterson Equipment Co., Inc.
4. Trerice, H. O. Co.
6. Or approved equal.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 150 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.
1. Insert material for water service at 20 to 200 deg F shall be CR.
2. Insert material for water service at minus 30 to plus 275 deg F shall be EPDM.

PART 3 - EXECUTION

3.01 THERMOMETER AND GAGE APPLICATIONS

A. Install thermometers in the outlet of each domestic, hot-water storage tank.
B. Install thermometers at suction and discharge of each pump.

C. Provide the following temperature ranges for thermometers:
   1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
   2. Domestic Cold Water: 30 to 130 deg F, with 2-degree scale divisions.

D. Install pressure gages at suction and discharge of each pump.

3.02 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

C. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.

D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

E. Install remote-mounting pressure gages on panel.

F. Install needle-valve and snubber fitting in piping for each pressure gage.

G. Install test plugs in tees in piping.

H. Install permanent indicators on walls or brackets in accessible and readable positions.

I. Install connection fittings for attachment to portable indicators in accessible locations.

J. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.

K. Adjust faces of thermometers and gages to proper angle for best visibility.
END OF SECTION 22 05 19
SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following general-duty valves:
   1. Bronze angle valves.
   2. Copper-alloy ball valves.
   4. Spring-loaded, lift-disc check valves.

B. Related Sections include the following:
   1. Division 220553 Section "Identification for Plumbing Piping and Equipment" for valve tags and charts.
   2. Division 22 piping Sections for specialty valves applicable to those Sections only.

1.03 RELATED SECTIONS

A. Section 220500 Common Work Results For Plumbing.

B. Section 221116 Domestic Water Piping.

1.04 DEFINITIONS

A. The following are standard abbreviations for valves:
   1. CWP: Cold working pressure.
   2. EPDM: Ethylene-propylene-diene terpolymer rubber.
   3. NBR: Acrylonitrile-butadiene rubber.
   4. PTFE: Polytetrafluoroethylene plastic.
   5. TFE: Tetrafluoroethylene plastic.
1.05 **SUBMITTALS**

   **A. Product Data:** For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.06 **QUALITY ASSURANCE**

   **A. ASME Compliance for Ferrous Valves:** ASME B16.10 and ASME B16.34 for dimension and design criteria.

   **B. NSF Compliance:** NSF 61 for valve materials for potable-water service.

   **C. All valves handling potable water shall be lead-free.**

1.07 **DELIVERY, STORAGE, AND HANDLING**

   **A. Prepare valves for shipping as follows:**
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Block check valves in either closed or open position.

   **B. Use the following precautions during storage:**
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

**PART 2 - PRODUCTS**

2.01 **MANUFACTURERS**

   **A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:**
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 **VALVES, GENERAL**

   **A. Refer to Part 3 "Valve Applications" Article for applications of valves.**
B. **Bronze Valves:** NPS 2 and smaller with threaded or press ends, unless otherwise indicated.

C. **Ferrous Valves:** NPS 2-1/2 and larger with flanged or press ends, unless otherwise indicated.

D. **Valve Pressure and Temperature Ratings:** Not less than indicated and as required for system pressures and temperatures.

E. **Valve Sizes:** Same as upstream pipe, unless otherwise indicated.

F. **Valve Actuators:**
   1. **Lever Handle:** For quarter-turn valves NPS 6 and smaller, except plug valves.
   2. **Wrench:** For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

G. **Extended Valve Stems:** On insulated valves.

H. **Valve Flanges:** ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

I. **Valve Grooved Ends:** AWWA C606.
   1. **Solder Joint:** With sockets according to ASME B16.18.
      a. **Caution:** Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
   2. **Threaded:** With threads according to ASME B1.20.1.

J. **Valve Bypass and Drain Connections:** MSS SP-45.

### 2.03 BRONZE ANGLE VALVES

A. **Available Manufacturers:**

B. **Manufacturers:**
   1. **Type 2, Bronze Angle Valves with Nonmetallic Disc:**
      a. American Valve, Inc.
      b. Cincinnati Valve Co.
      c. Crane Co.; Crane Valve Group; Crane Valves.
      d. Crane Co.; Crane Valve Group; Jenkins Valves.
      e. Crane Co.; Crane Valve Group; Stockham Div.
      f. Grinnell Corporation.
      g. Hammond Valve.
      h. NIBCO INC.
      i. Powell, Wm. Co.
C. Bronze Angle Valves, General: MSS SP-80, with ferrous-alloy handwheel.

D. Type 2, Class 125, Bronze Angle Valves: Bronze body with PTFE disc and union-ring bonnet.

2.04 COPPER-ALLOY BALL VALVES

A. Available Manufacturers:

B. Manufacturers:
   1. Two-Piece, Copper-Alloy Ball Valves:
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Crane Co.; Crane Valve Group; Jenkins Valves.
      d. Crane Co.; Crane Valve Group; Stockham Div.
      e. DynaQuip Controls.
      f. Flow-Tek, Inc.
      g. Grinnell Corporation.
      h. Hammond Valve.
      i. Jamesbury, Inc.
      j. Jomar International, LTD.
      k. Kitz Corporation of America.
      l. Legend Valve & Fitting, Inc.
      m. Jomar.
      n. Nexus Valve Specialties.
      o. NIBCO INC.
      p. Red-White Valve Corp.
      q. Richards Industries; Marwin Ball Valves.
      r. Watts Industries, Inc.; Water Products Div.

C. Copper-Alloy Ball Valves, General: MSS SP-110

D. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

2.05 BRONZE CHECK VALVES

A. Available Manufacturers:

B. Manufacturers:
   1. Type 2, Bronze, Horizontal Lift Check Valves with Nonmetallic Disc:
      a. Cincinnati Valve Co.
      b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Walworth Co.

2. Type 1, Bronze, Vertical Lift Check Valves with Metal Disc:
a. Cincinnati Valve Co.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Red-White Valve Corp.

e. Crane Co.; Crane Valve Group; Jenkins Valves.

3. Type 2, Bronze, Vertical Lift Check Valves with Nonmetallic Disc:
a. Grinnell Corporation.
b. Kitz Corporation of America.
c. Jomar.

4. Type 3, Bronze, Swing Check Valves with Metal Disc:
a. American Valve, Inc.
b. Cincinnati Valve Co.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. Grinnell Corporation.
g. Hammond Valve.
h. Kitz Corporation of America.
i. Legend Valve & Fitting, Inc.
j. Jomar.
k. NIBCO INC.
l. Powell, Wm. Co.
m. Red-White Valve Corp.
n. Walworth Co.
o. Watts Industries, Inc.; Water Products Div.

5. Type 4, Bronze, Swing Check Valves with Nonmetallic Disc:
a. Cincinnati Valve Co.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Grinnell Corporation.
f. Hammond Valve.
g. McWane, Inc.; Kennedy Valve Div.
h. Jomar.
i. NIBCO INC.
j. Red-White Valve Corp.
k. Walworth Co.

C. Bronze Check Valves, General: MSS SP-80.

D. Type 2, Class 125, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

E. Type 2, Class 125, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

F. Type 2, Class 150, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

G. Type 2, Class 150, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

2.06 SPRING-LOADED, LIFT-DISC CHECK VALVES

A. Available Manufacturers:

B. Manufacturers:
   1. Type I, Wafer Lift-Disc Check Valves:
      a. Mueller Steam Specialty.
   2. Type II, Compact-Wafer, Lift-Disc Check Valves:
      a. Durabla Fluid Technology, Inc.
      b. Flomatic Valves.
      c. GA Industries, Inc.
      d. Grinnell Corporation.
      e. Hammond Valve.
      f. Metraflex Co.
      g. Jomar.
      h. Mueller
      i. NIBCO INC.
   3. Type III, Globe Lift-Disc Check Valves:
      a. Durabla Fluid Technology, Inc.
      b. Flomatic Valves.
      c. GA Industries, Inc.
      d. Grinnell Corporation.
      e. Hammond Valve.
      f. Metraflex Co.
      g. Jomar.
h.   NIBCO INC.

4. Type IV, Threaded Lift-Disc Check Valves:
a.   Check-All Valve Mfg. Co.
b.   Durabla Fluid Technology, Inc.
c.   Grinnell Corporation.
d.   Legend Valve & Fitting, Inc.
e.   Metraflex Co.
f.   Jomar.
g.   Mueller
h.   NIBCO INC.
i.   Watts Industries, Inc.; Water Products Div.

C. Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.

D. Type I, Class 125, Wafer Lift-Disc Check Valves: Wafer style with cast-iron shell with diameter matching companion flanges.

E. Type I, Class 250, Wafer Lift-Disc Check Valves: Wafer style with cast-iron shell with diameter matching companion flanges.

F. Type II, Class 125, Compact-Wafer, Lift-Disc Check Valves: Compact-wafer style with cast-iron shell with diameter made to fit within bolt circle.

G. Type II, Class 250, Compact-Wafer, Lift-Disc Check Valves: Compact-wafer style with cast-iron shell with diameter made to fit within bolt circle.

H. Type III, Class 125, Globe Lift-Disc Check Valves: Globe style with cast-iron shell and flanged ends.

I. Type III, Class 250, Globe Lift-Disc Check Valves: Globe style with cast-iron shell and flanged ends.

J. Type IV, Class 125, Threaded Lift-Disc Check Valves: Threaded style with bronze shell and threaded ends.

K. Type IV, Class 150, Threaded Lift-Disc Check Valves: Threaded style with bronze shell and threaded ends.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball valves.
   2. Throttling Service: Angle or ball valves.

B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.

C. Domestic Water Piping: Use the following types of valves:
   1. Angle Valves, NPS 2 and Smaller: Type 2, Class 125, 150, 200 bronze.
   2. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, copper alloy.
   3. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
   4. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 150, 200 horizontal or vertical, bronze.
   5. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 150, 200 bronze.
   6. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
3.03 **VALVE INSTALLATION**

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

3.04 **JOINT CONSTRUCTION**

A. Refer to Division 220500 Section "Common Work Results for Plumbing" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.05 **ADJUSTING**

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 22 05 23
SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Fiberglass pipe hangers.
   4. Metal framing systems.
   5. Fiberglass strut systems.
   6. Pipe positioning systems.
   7. Equipment supports

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including “Uniform General Conditions for State of Texas Construction Contracts Including Supplementary General Conditions for Projects Administered by the Texas Parks and Wildlife Department” apply to this Section.

1.03 RELATED SECTIONS

A. Section 220500 Common Work Results For Plumbing.

B. Section 221116 Domestic Water Piping.

C. Section 221316 Sanitary Waste and Vent Piping.

D. Section 220700 Plumbing Insulation.

1.04 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."
1.05 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

1.06 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Fiberglass pipe hangers.
   3. Thermal-hanger shield inserts.
   4. Pipe positioning systems.
   5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

1.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1.02 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers:
   1. AAA Technology & Specialties Co., Inc.
   2. Bergen-Power Pipe Supports.
   4. Carpenter & Paterson, Inc.
   5. Empire Industries, Inc.
   6. ERICO/Michigan Hanger Co.
   7. Globe Pipe Hanger Products, Inc.
   8. Grinnell Corp.
   9. GS Metals Corp.
  11. PHD Manufacturing, Inc.
  12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

1.03 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

1.04 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane or stainless steel.
   1. Manufacturers:
      b. Champion Fiberglass, Inc.
      d. Seasafe, Inc.
      e. Unistrut Corp.; Tyco International, Ltd.
      f. Wesanco, Inc.

B. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.
   1. Available Manufacturers:
      a. Plasti-Fab, Inc.

1.05 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Available Manufacturers:
   2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
   3. GS Metals Corp.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

1.06 FIBERGLASS STRUT SYSTEMS

A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.

B. Available Manufacturers:
   2. Champion Fiberglass, Inc.
   3. Cope, T. J., Inc.; Tyco International Ltd.
   4. Seasafe, Inc.

1.07 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

B. Available Manufacturers:
   2. HOLDRITE Corp.; Hubbard Enterprises.
   3. Samco Stamping, Inc.

1.08 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

1.09 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
PART 3 - EXECUTION

1.01 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
  10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
4. Metal Saddles Sizing:
   - Pipe Size: 3/4" to 3". 18 gauge, 12" long.
- Pipe Size: 4" to 6". 16 gauge, 12" - 18" long.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

1.02 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.

F. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.


J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping.

M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

O. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.

6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

1.03 EQUIPMENT SUPPORTS
   A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
   B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
   C. Provide lateral bracing, to prevent swaying, for equipment supports.

1.04 METAL FABRICATIONS
   A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
   B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
   C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
      1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
      2. Obtain fusion without undercut or overlap.
      3. Remove welding flux immediately.
      4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

1.05 ADJUSTING
   A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
   B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

1.06 PAINTING
   A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
      1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
   B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 22 05 29
SECTION 22 05 33 – HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes plumbing piping heat tracing for freeze prevention, domestic hot-water-temperature maintenance, and snow and ice melting on roofs and in gutters and downspouts with the following electric heating cables:
   1. Self-regulating, parallel resistance.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including “Uniform General Conditions for State of Texas Construction Contracts Including Supplementary General Conditions for Projects Administered by the Texas Parks and Wildlife Department” apply to this Section.

1.03 RELATED SECTIONS

A. Section 221116 Domestic Water Piping.

1.04 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
   1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Owner Acceptance.

PART 2 - PRODUCTS

1.01 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Comply with IEEE 515.1.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. BriskHeat
   2. Chromalox, Inc.
   3. Delta-Therm Corporation.
   4. Easy Heat Inc.
   6. nVent
   7. Thermon
   8. Trasor Corp.

C. Heating Element: Pair of parallel stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

D. Electrical Insulating Jacket: Flame-retardant polyolefin.

E. Cable Cover: Stainless-steel braid, and polyolefin outer jacket with UV inhibitor.

F. Maximum Operating Temperature (Power On): 150 deg F.

G. Maximum Exposure Temperature (Power Off): 185 deg F.

H. Capacities and Characteristics: As per drawings.

1.02 CONTROLS

A. Pipe-Mounting Thermostats for Freeze Protection:
   1. Remote bulb unit with adjustable temperature range from 30 to 50 deg.
   2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
   3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
1.03 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Refer to Division 22 Section "Identification for Plumbing Piping and Equipment."

C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
   2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

1.01 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

1.02 INSTALLATION

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written recommendations using cable protection conduit and slack cable to allow movement without damage to cable.

B. Electric Heating Cable Installation for Freeze Protection for Piping:
   1. Install electric heating cables after piping has been tested and before insulation is installed.
   2. Install electric heating cables according to IEEE 515.1.
   3. Install insulation over piping with electric cables according to Division 22 Section "Plumbing Insulation."
   4. Install warning tape on piping insulation where piping is equipped with electric heating cables.

C. Set field-adjustable switches and circuit-breaker trip ranges.

D. Protect installed heating cables, including nonheating leads, from damage.

1.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

1.04 FIELD QUALITY CONTROL

A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
   1. Test cables for electrical continuity and insulation integrity before energizing.
   2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.

C. Remove and replace malfunctioning units and retest as specified above.

1.05 PROTECTION

A. Protect installed heating cables, including noneating leads, from damage during construction.

B. Remove and replace damaged heat-tracing cables.

END OF SECTION 22 0533
SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Valve tags.
   5. Warning tags.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including “Uniform General Conditions for State of Texas Construction Contracts Including Supplementary General Conditions for Projects Administered by the Texas Parks and Wildlife Department” apply to this Section.

1.03 RELATED SECTIONS

A. Section 223300 Electric Domestic Water Heaters.

B. Section 221119 Domestic Water Piping Specialties.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Submit a list of all piping systems to be identified, color of background to be used, legend or wording to be displayed for each system, and the intended location of all markers to be displayed.

C. Samples: For color, letter style, and graphic representation required for each identification material and device.

D. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

E. Valve numbering scheme.

F. Valve Schedules: For each piping system to include in maintenance manuals.
1.05 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Cover and protect material in transit and at site. Material not properly protected, stored, and which is damaged or defaced during construction shall be rejected and replaced at no cost to the owner.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment: (Black background with white lettering)
1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches and 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. **Adhesive:** Contact-type permanent adhesive, compatible with label and with substrate.

C. **Label Content:** Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. **Equipment Label Schedule:** For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

E. Provide and install identification plates on the covers of all starters or disconnects or combination starter-disconnects, where not mounted directly on the equipment, delivered by the mechanical system installer to the electrical system installer and on each piece of equipment to include:
   1. Pumps.
   2. Backflow prevention devices.
   4. Rainwater Harvesting Tanks.
   5. Expansion tanks.

### 2.02 WARNING SIGNS AND LABELS

A. **Material and Thickness:** Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. **Letter Color:** Red.

C. **Background Color:** White.

D. **Maximum Temperature:** Able to withstand temperatures up to 160 deg F.

E. **Minimum Label Size:** Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. **Minimum Letter Size:** 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. **Fasteners:** Stainless-steel rivets or self-tapping screws.

H. **Adhesive:** Contact-type permanent adhesive, compatible with label and with substrate.
I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS: Note that pipe labels shall follow the Pipe Label Schedule below.

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive. For indoor insulated piping greater than 6” Insulation OD, labels may be secured with plastic zip ties. For similar outdoor piping a metal strap or cable can be used.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size:

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Letter Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75” to 1.25”</td>
<td>0.5”</td>
</tr>
<tr>
<td>1.5” to 2”</td>
<td>0.75”</td>
</tr>
<tr>
<td>2.5” to 6”</td>
<td>1.25”</td>
</tr>
<tr>
<td>8” to 10”</td>
<td>2.5”</td>
</tr>
<tr>
<td>10” and up</td>
<td>3.5”</td>
</tr>
<tr>
<td>SERVICE</td>
<td>MARK</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Domestic hot water supply</td>
<td>HWS</td>
</tr>
<tr>
<td>Domestic hot water return</td>
<td>HWR</td>
</tr>
<tr>
<td>Domestic cold water supply</td>
<td>CWS</td>
</tr>
<tr>
<td>Sanitary Sewer – Gravity</td>
<td>SAN</td>
</tr>
<tr>
<td>Sanitary Sewer Vent</td>
<td>VENT</td>
</tr>
</tbody>
</table>

2.04 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7 inches.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

2.05 VALVE TAGS

A. Wire onto the handle of each valve installed a 19-gauge brass disc not under one and one-half inches (1-1/2") in diameter stamped with 1/4" high black paint filled letters over 1/2" high black paint filled numbers. Use "PLBG" as letters for Plumbing Valves, "HVAC" for Air Conditioning System Refrigerant Valves, followed by an identifying number. Tags shall be equivalent to Seton Style 250-BL.

B. Secure valve tags to valves by use of brass "S" hooks or brass jack chains.

C. The number, location, and purpose corresponding to each valve shall be listed in sequence, properly typewritten on a schedule sheet to be turned over to the Owner.

D. Provide two (2) framed valve tag charts with typed schedule sheets contained therein. Charts shall have an aluminum frame with clear plastic or lexan window.
PART 3 - EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surface of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

3.04 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.05 VALVE TAG INSTALLATION

A. Secure Valve tags to each valve with Brass "S" hooks or jack chains on each valve stem corresponding to the valve tag chart list.

B. Secure Valve Tag Chart List to Central Mechanical Room wall near the main entry at 60" above finished floor or where otherwise directed by Architect. Provide second chart to Owner of their disposition.

END OF SECTION 22 05 53
SECTION 22 0700 - PLUMBING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Insulation Materials:
      a. Flexible elastomeric.
      b. Mineral fiber.
   2. Insulating cements.
   3. Adhesives.
   5. Sealants.
   6. Field-applied jackets.
   7. Tapes.
   8. Securements.
   9. Corner angles.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including “Uniform General Conditions for State of Texas Construction Contracts Including Supplementary General Conditions for Projects Administered by the Texas Parks and Wildlife Department” apply to this Section.

1.03 RELATED SECTIONS

A. Section 220500 Common Work Results For Plumbing.

B. Section 221116 Domestic Water Piping.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Qualification Data: For qualified Installer.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers,
attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

D. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Materials not properly protected and stored, which is damaged/deteriorated shall be rejected. Damaged materials shall be replaced at no cost to the owner.

1.07 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, plutonium, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Duct Wrap.
      d. Manson Insulation Inc.; Alley Wrap.
      e. Owens Corning; All-Service Duct Wrap.
H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; Commercial Board.
   b. Fibrex Insulations Inc.; FBX.
   c. Johns Manville; 800 Series Spin-Glas.
   d. Knauf Insulation; Insulation Board.
   e. Manson Insulation Inc.; AK Board.
   f. Owens Corning; Fiberglas 700 Series.

I. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Fibrex Insulations Inc.; Coreplus 1200.
   b. Johns Manville; Micro-Lok.
   c. Knauf Insulation; 1000(Pipe Insulation.
   d. Manson Insulation Inc.; Alley-K.
   e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in. /h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Manson Insulation Inc.; AK Flex.
   e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.02 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-82.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2.03 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
e. Mon-Eco Industries, Inc.; 55-10.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products, Division of ITW; Encacel.
   b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
   c. Marathon Industries, Inc.; 570.
   d. Mon-Eco Industries, Inc.; 55-70.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products, Division of ITW; CP-10.
   b. Foster Products Corporation, H. B. Fuller Company; 35-00.
   c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
   e. Mon-Eco Industries, Inc.; 55-50.
   f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.

2.04 SEALANTS

A. Joint Sealants:
1. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products, Division of ITW; CP-70.
   c. Marathon Industries, Inc.; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
B. FSK and Metal Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-76-8.
      b. Foster Products Corporation, H. B. Fuller Company; 95-44.
      c. Marathon Industries, Inc.; 405.
      d. Mon-Eco Industries, Inc.; 44-05.
      e. Vimasco Corporation; 750.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-76.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.

2.05 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.06 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
      b. Compac Corp.; 104 and 105.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
      b. Compac Corp.; 110 and 111.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
      d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
   2. Width: 3 inches.
   3. Thickness: 6.5 mils.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
      b. Compac Corp.; 130.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
      d. Venture Tape; 1506 CW NS.
   2. Width: 2 inches.
   3. Thickness: 6 mils.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
      b. Compac Corp.; 120.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
      d. Venture Tape; 3520 CW.
   2. Width: 2 inches.
   3. Thickness: 3.7 mils.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.07 SECUREMENTS

A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products; Bands.
   b. PABCO Metals Corporation; Bands.
   c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209 Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal

2.08 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch aluminum according to ASTM B 209 Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.
PART 3 - EXECUTION

3.01  EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02  PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that applies to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03  GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   5. Handholes.
   6. Cleanouts.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
   6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient
services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.07 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

3.08 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant.
recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:
1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch circumference limit allows for 2-inch overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.09 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.010 FIELD QUALITY CONTROL

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

C. Tests and Inspections:
   1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
   2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.011 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Underground piping.
   2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.012 INDOOR PIPING INSULATION SCHEDULE (ALL OVERHEAD PIPING SHALL BE INSULATED WITH PLENUM RATED MATERIAL. TYPICAL)

A. Domestic Cold Water:
   1. NPS 1-1/2 and Smaller: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1/2 inch thick.
      b. Mineral-Fiber or Fiberglass, Preformed Pipe Insulation, Type I: 1 inch thick.
   2. NPS 2 and Larger: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber or Fiberglass, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot Recirculated Hot Water: Note that valves are considered part of the piping system and shall be insulated.
   a. Mineral-Fiber or Fiberglass, Preformed Pipe Insulation, Type I: 1 inch thick.
C. Condensate and Equipment Drain Water:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 3/4 inch thick.

D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 3/4 inch thick.

END OF SECTION 22 07 00
SECTION 22 11 13 – FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for water service.

B. Reference civil drawings C7.01 through C7.03

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including “Uniform General Conditions for State of Texas Construction Contracts Including Supplementary General Conditions for Projects Administered by the Texas Parks and Wildlife Department” apply to this Section.

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

C. Reference civil drawings

1.3 RELATED SECTIONS

A. 22 13 13 – FACILITY SANITARY SEWERS

1.4 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

C. Field quality-control test reports.
1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. NSF Compliance:
   1. Comply with NSF 14 for plastic potable-water-service piping.
   2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves according to the following:
   1. Ensure that valves are dry and internally protected against rust and corrosion.
   2. Protect valves against damage to threaded ends and flange faces.
   3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves according to the following:
   1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
   2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.
G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Owner no fewer than five days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Owner’s written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC, Schedule 40 and 80 Pipe: ASTM D 1785.

1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.
2. PVC, Schedule 40 Socket Fittings: ASTM D 2467.

2.2 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:
   a. Refer to Mueller Co. or approved equivalent.

2.4 CHECK VALVES

A. AWWA Check Valves:
   a. Refer to Mueller Co. or approved equivalent.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.
3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping 1” through 4” shall be the following:

F. Water-service piping materials listed in subparagraphs below are for potable water. They may not be suitable for fire-service mains.
   1. PVC, Schedule 40 pipe: socket fittings; and solvent-cemented joints.

G. Aboveground water-service piping 1” through 4” shall be the following:
   1. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented, or threaded fittings; and threaded joints.

H. Bury piping with depth of cover over top at least 30”.

I. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

J. Terminate water distribution piping at 5’ outside of the building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

K. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.3 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

   1. Concrete thrust blocks.
   2. Locking mechanical joints.
   3. Bolted flanged joints.
3.4 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

3.5 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.6 IDENTIFICATION

A. Install continuous underground detectable (with tracer wire) warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping embedment. Underground warning tapes are specified in Section 312000 "Earth Moving."

3.7 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.

2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.

b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.

c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.

d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113
SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. NSF/ANSI 14 – Plastic Piping System Components and Related Materials

C. NSF/ANSI 61 – Drinking Water Systems Components – Health Effects

1.02 SUMMARY

A. This Section includes domestic water piping inside the building.

B. Water meters will be furnished and installed by utility company.

C. Related Sections include the following:
   1. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.03 RELATED SECTIONS

A. Section 220500 Common Work Results For Plumbing.

B. Section 312000 Earth Moving.

C. Section 220523 General-Duty Valves for Plumbing Piping.

1.04 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

1.05 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.


C. Field quality-control test reports.
1.06 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

C. Material shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.

D. Material shall comply with manufacturers specifications.

E. Special Engineered products shall be certified by NSF International as complying with NSF 14.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.03 PEXa TUBE AND FITTINGS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   1. Uponor
   2. Rehau
   3. Or approved equal.

B. Piping
   1. All pipe shall be high-density crosslinked polyethylene manufactured using the high-pressure peroxide method of crosslinking (PEXa). Pipe shall conform to ASTM F876, ASTM F877 CSA B137.5, NSF/ANSI 14, and NSF/ANSI 61.
2. Pipe shall be rated for continuous operation of 100 psi gauge pressure at 180°F temperature, and shall have a rating of 80 psi gauge pressure at 200°F temperature per the manufacturer’s requirements.

3. Pipe shall be certified by PPI to standard TR-3, with applicable plumbing and mechanical code certifications.

4. Pipe to be manufactured using a high-pressure peroxide method with a minimum degree of crosslinking of 70-89% when tested in accordance with ASTM D2765, Method B.

5. Pipe to be tested for resistance to hot chlorinated water in accordance with ASTM F2023. Pipe to have a minimum extrapolated time-to-failure of 50 years, calculated in accordance with section 13.3 of F2023 and listed as “3306” per the ASTM F876 standard.

6. Pipe to have a minimum bend radius for cold bending not less than five (5) times the outside diameter. Bends with a radius less than this shall require the use of bending template as supplied by the pipe manufacturer, and/or hot air.

7. PEXa pipe to have a co-extruded red, white or blue UV Shield made from UV-resistant polyethylene providing a minimum UV resistance of 6 months when tested according to ASTM F2657. In addition, pipe shall have a manufacturer’s recommended UV resistance of 12 months based on additional testing to ASTM F2657.

8. Pipe to have a Flame Spread Index and a Smoke Developed Index listing to ASTM E84 (in U.S.) or CAN/ULC S102.2 (in Canada) with insulation or galvanized support channel as necessary.

C. Fittings
1. All Fittings used with crosslinked polyethylene (PEXa) water distribution pipe intended for plumbing applications shall be cold-expansion PEXa compression-sleeve fittings.
2. All polymer fittings shall be made from PPSU (black) in accordance with ASTM D6394.
3. All brass fittings shall be lead free brass made from ECO BRASS UNS C69300 or equivalent.
4. All compression sleeves shall be made from PEXa crosslinked polyethylene.
5. All fittings shall be third-party certified to applicable standards ASTM F877, NSF/ANSI 14, NSF/ANSI 61 and CSA B137.5.
6. Where joints are encased in concrete or buried underground, joints shall be wrapped if required per the manufacturer’s recommendation to protect the material.

D. Assembly Tools
1. Tools for assembling PEXa pipe and compression-sleeve fittings shall be part of the manufacturer’s cataloged program.
2. Manufacturer of PEXa pipe and fittings shall provide a warranty for the assembly tools of 2 years.

2.04 VALVES

A. Bronze and cast-iron, general-duty valves are specified in Division 220523 Section "General-Duty Valves for Plumbing Piping."
PART 3 - EXECUTION

3.01 EXCAVATION
A. Excavating, trenching, and backfilling are specified in Division 312000 Section "Earth Moving."

3.02 PIPE AND FITTING APPLICATIONS
A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
B. Flanges may be used on aboveground piping, unless otherwise indicated.
C. Under-Building-Slab, Water-Service Piping on Service Side of Water Meter: Refer to civil.
D. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter, NPS 4 and Smaller: PEX tube with cold expansion fittings. Provide all under slab/pavement PEX within schedule 40 PVC conduit.
E. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
   1. NPS 1 and Smaller: PEX tube with cold expansion fittings.
   2. NPS 1-1/4 and NPS 1-1/2: PEX tube with cold expansion fittings.

3.03 VALVE APPLICATIONS – See specification section “GENERAL DUTY VALVES FOR PLUMBING PIPING”.

3.04 PIPING INSTALLATION
A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 220500 Section "Common Work Results for Plumbing."
E. Install domestic water piping level and plumb.

F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

I. Install piping to permit valve servicing.

J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections.

M. All cold-expansion PEXa compression-sleeve fittings shall be assembled using the manufacturer’s approved tools and must consist of the following process
   1. Make a clean, square cut of the PEXa pipe
   2. Slide the PEXa compression sleeve over the PEXa pipe
   3. Expand the PEXa pipe twice with a rotation between expansions
   4. Insert the cold-expansion compression-sleeve fitting into the expanded PEXa pipe
   5. Compress the PEXa compression sleeve over the PEXa pipe and fitting using only tools from the manufacturer’s cataloged program.

3.05 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 220500 Section "Common Work Results for Plumbing."

B. Ream ends of pipes and tubes and remove burrs.

C. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

D. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.
3.06  **HANGER AND SUPPORT INSTALLATION**

A. Pipe hanger and support devices are specified in Division 220529 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls.
      Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Install vinyl-coated hangers for PEX tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

F. Maximum spans below were taken from MSS SP-69 for water service and from model plumbing codes. Most restrictive piping and spacing dimensions are shown.

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07  **CONNECTIONS**

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve, and extend and connect to the following (as applicable):
   1. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
3. **Equipment:** Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.08 FIELD QUALITY CONTROL

A. **Inspect domestic water piping as follows:**
   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
   4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. **Test domestic water piping as follows:**
   1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

C. **Test domestic hot water circulating as follows:** Balance and check prior to final inspection and provided with sufficient thermometers installed at time of final construction review to prove that water is circulating in all piping loops to fixtures.

D. **Defective work:**
1. If inspection or test shows defects, defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated.
2. Repairs to piping shall be made with new materials.
3. No caulking or screwed joints or holes will be acceptable.

### 3.09 ADJUSTING

**A.** Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.010 CLEANING

**A.** Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

**B.** Prepare and submit reports of purging and disinfecting activities.

**C.** Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 22 11 16
SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following domestic water piping specialties:
   1. Vacuum breakers.
   2. Backflow preventers.
   3. Temperature-actuated water mixing valves.
   4. Strainers.
   5. Outlet boxes.
   6. Hose bibbs.
   7. Wall/Ground hydrants.
   8. Drain valves.

1.02 RELATED DOCUMENTS

B. Drawings and general provisions of the Contract, including “Uniform General Conditions for
   State of Texas Construction Contracts Including Supplementary General Conditions for
   Projects Administered by the Texas Parks and Wildlife Department” apply to this Section.

1.03 RELATED SECTIONS

C. Section 220500 Common Work Results For Plumbing.

D. Section 221116 Domestic Water Piping.

E. Section 223300 Electric Domestic Water Heaters.

1.04 PERFORMANCE REQUIREMENTS

F. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise
   indicated.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Note: No lead shall be in contact with potable water.

B. All piping, fittings and valves shall be of US manufacture. Provide proof of domestic manufacturing.

C. NSF Compliance:
   2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.01 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ames Co.
      b. Cash Acme.
      c. Conbraco Industries, Inc.
      d. FEBCO; SPX Valves & Controls.
      e. Rain Bird Corporation.
      f. Toro Company (The); Irrigation Div.
      g. Watts Industries, Inc.; Water Products Div.
      h. Or equal.
   3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
   5. Inlet and Outlet Connections: Threaded.

B. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrowhead Brass Products, Inc.
   b. Cash Acme.
   c. Conbraco Industries, Inc.
   d. Legend Valve.
   e. Prier Products, Inc.
   g. Woodford Manufacturing Company.
   h. Or equal.


5. Finish: Chrome or nickel plated, Rough bronze.

C. Pressure Vacuum Breakers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. Ames Co.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Flomatic Corporation.
   e. Toro Company (The); Irrigation Div.


3. Operation: Continuous-pressure applications.

4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.

5. Size: As per Drawings

6. Design Flow Rate: As per Drawings

7. Selected Unit Flow Range Limits: As Per Drawings

8. Pressure Loss at Design Flow Rate: As per Drawings

9. Accessories:
   a. Valves: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   c. Or equal.


3. Operation: Continuous-pressure applications.

4. Size: As shown on Drawings
5. Accessories:
   a. Valves: Ball type, on inlet and outlet.

2.02 BACKFLOW PREVENTERS

E. Double-Check Backflow-Prevention Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ames Co.
      b. Conbraco Industries, Inc.
      c. FEBCO; SPX Valves & Controls.
      d. Flomatic Corporation.
      e. Watts Industries, Inc.; Water Products Div.
   3. Operation: Continuous-pressure applications, unless otherwise indicated.
   4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
   5. Size: As required to limit pressure loss.
   6. Design Flow Rate: See schedule.
   7. Selected Unit Flow Range Limits: Gpm corresponding to maximum pressure loss allowed.
   8. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
   9. End Connections: Threaded or press for NPS 2 and smaller; flanged or grooved for NPS 2-1/2 and larger.
   11. Accessories:
      a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

F. Hose-Connection Backflow Preventers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.
      c. Woodford Manufacturing Company.
      d. Or equal.
   3. Operation: Up to 10-foot head of water back pressure.
   4. Inlet Size: NPS 1/2 or NPS 3/4.
   5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
   6. Capacity: At least 3-gpm flow.

G. Ice-Machine Backflow Preventer: Watts LF007 or approved equal.
2.03 OUTLET BOXES

H. Icemaker Outlet Boxes (with integral water hammer arrestor):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. IPS Corporation.
   c. LSP Products Group, Inc.
   d. Oatey.
   e. Plastic Oddities; a division of Diverse Corporate Technologies.
   f. Or equal.
2. Mounting: Recessed, less flange.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.04 HOSE BIBBS

A. Hose Bibbs:
1. Refer to plans for specifications.
7. Include integral wall flange with each chrome-plated hose bibb.

2.05 WALL HYDRANTS

A. Wall Hydrants (non-freeze):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam
   b. Mansfield Plumbing Products LLC.
   d. Prier Products, Inc.
   g. Woodford Manufacturing Company.
   h. Or equal.
2. Standard: ASSE 1019, Type A or Type B.
3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.

2.06 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMTROL, Inc.
   b. Josam Company.
   c. PPP Inc.
   d. Sioux Chief Manufacturing Company, Inc.
   e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   f. Tyler Pipe; Wade Div.
   g. Watts Drainage Products Inc.
   h. Or equal.
3. Type: Metal bellows
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.07 STRAINERS

A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded or press for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.

2.08 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
2. Pressure Rating: 400-psig minimum CWP.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
8. Inlet: Threaded or solder joint.

B. Gate-Valve-Type, Hose-End Drain Valves:
2. Pressure Rating: Class 125.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:
1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
5. Drain: NPS 1/8 side outlet with cap.

2.09 TEMPERATURE-ACTUATED WATER MIXING VALVES

D. Individual-Fixture, Water Tempering Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. Honeywell Water Controls.
   d. Lawler Manufacturing Company, Inc.
   e. Leonard Valve Company.
   f. Powers; a Watts Industries Co.
   g. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1070, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: Refer to plans for temperature setting.
9. Tempered-Water Design Flow Rate: Refer to plans for fixture GPMs.

PART 3 - EXECUTION

3.01 INSTALLATION
A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to equipment and water systems that may be sources of contamination in addition to those shown on the plans. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Do not install bypass piping around backflow preventers.

C. Install Y-pattern strainers for water on supply side of each manifold and pump.

D. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs.

E. Install water hammer arresters in water piping according to PDI-WH 201.

F. All individual fixture thermostatic mixing valves shall be concealed in walls or within casework and fully accessible for service, repair, or replacement through an adequately sized access door panel with a loose key lock.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following (as applicable):
   1. Double-check backflow-prevention assemblies.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
1. Test each pressure vacuum breaker and double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.05 ADJUSTING

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 11 19
SECTION 22 13 13 – FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Nonpressure and pressure couplings.
3. Expansion joints and deflection fittings.
5. Manholes.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including "Uniform General Conditions for State of Texas Construction Contracts Including Supplementary General Conditions for Projects Administered by the Texas Parks and Wildlife Department" apply to this Section.

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

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. For each type of item indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of pipe and fitting, from manufacturer.

B. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.
C. Handle manholes according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than five days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner’s written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, SDR-35 PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.

B. PVC Pressure Piping:

1. Pipe: Schedule 40 and 80 Bell & Spigot PVC per ASTM D 1785
2. Fittings: ASTM D 2466 for schedule 40, ASTM D 2467 for schedule 80
3. Joints: Solvent welded per ASTM D 2855-15

2.2 CLEANOUTS

1. Refer to plans

2.3 Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 6-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: 6-inch minimum thickness, of length to provide depth indicated.
6. **Top Section:** Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.

7. **Joint Sealant:** ASTM C 990, bitumen or butyl rubber.

8. **Resilient Pipe Connectors:** ASTM C 923, cast or fitted into manhole walls, for each pipe connection.

9. **Grade Rings:** Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

**B. Manhole Frames and Covers:**

1. Refer to Plans

**2.4 CONCRETE**

**A. General:** Cast-in-place concrete complying with ACI 318, ACI 350/350R, and the following:

1. **Cement:** ASTM C 150, Type II.
2. **Fine Aggregate:** ASTM C 33, sand.
3. **Coarse Aggregate:** ASTM C 33, crushed gravel.
4. **Water:** Potable.

**B. Portland Cement Design Mix:** 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. **Reinforcing Fabric:** ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. **Reinforcing Bars:** ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

**C. Manhole Channels and Benches:** Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. **Channels:** Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
   a. **Invert Slope:** 2 percent through manhole.

2. **Benches:** Concrete, sloped to drain into channel.
   a. **Slope:** 8 percent.

**D. Ballast and Pipe Supports:** Portland cement design mix, 3,000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. **Reinforcing Fabric:** ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. **Reinforcing Bars:** ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.
PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow, nonpressure, drainage piping according to the following:
   1. Install piping pitched down in direction of flow, at minimum slope of 2 percent unless otherwise indicated.
   2. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
   3. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.

F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:
   1. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
   2. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
   3. Join dissimilar pipe materials with nonpressure-type, flexible couplings.
B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
   a. Shielded flexible couplings for pipes of same or slightly different OD.
   b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure pipe couplings for force-main joints.

3.4 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Form continuous concrete channels and benches between inlets and outlet.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 6 inches above finished surface elsewhere unless otherwise indicated.

E. Install manhole-cover inserts in frame and immediately below cover.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.6 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

   1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
   2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
   3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 24 inches deep. Set with tops ½ inch above surrounding grade.
C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 IDENTIFICATION

A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
   1. Use detectable warning tape (with tracer wire) over nonferrous piping and over edges of underground manholes.

3.8 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
   1. Submit separate report for each system inspection.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.
   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Test completed piping systems according to requirements of authorities having jurisdiction.
   3. Schedule tests and inspections by authorities having jurisdiction with at least five days advance notice.
   4. Submit separate report for each test.
   5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
   6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction.
7. Manholes: Perform hydraulic test according to ASTM C 969.
   
   C. Leaks and loss in test pressure constitute defects that must be repaired.
   
   D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

   A. Clean dirt and superfluous material from interior of piping.

END OF SECTION 221313
PART 1 - GENERAL

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

1.02 SUMMARY
A. This Section includes the following for soil, waste, and vent piping inside the building:
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.

1.03 RELATED SECTIONS
A. Section 220500 Common Work Results For Plumbing.
B. Section 221319 Sanitary Waste and Vent Specialties.
C. Section 221413 Facility Storm Drainage Piping.
D. Section 312000 Earth Moving.

1.04 DEFINITIONS
A. LLDPE: Linear, low-density polyethylene plastic.
B. NBR: Acrylonitrile-butadiene rubber.

1.05 PERFORMANCE REQUIREMENTS
A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1.06 SUBMITTALS
A. Product Data: For pipe, tube, fittings, and couplings.
B. Shop Drawings:
1. Provide CAD generated shop drawings, 1/8” – 1'-0” minimum scale. Provide (2) hard copies for review.

C. Field quality-control inspection and test reports.

1.07 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   2. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

2.02 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.03 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS (Above grade only)

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

   a. Available Manufacturers:
      1) Conine Manufacturing
      2) SE Sovent

C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
   1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
      a. Available Manufacturers:
         1) ANACO.
   a. Available Manufacturers:
   1) ANACO.
   2) Charlotte Pipe
   3) Clamp-All Corp
   4) Dallas Specialty
   5) Ideal Clamp Products
   6) Mifab
   7) Mission Rubber Company
   8) NewAge Casting
   9) Tyler Pipe

D. Cast-Iron, Hubless-Piping Couplings:
   1. Available Manufacturers:
   1) Charlotte Pipe
   2) MG Piping Products
   3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.


C. Steel Pipe Pressure Fittings:
D. Cast-Iron Flanges: ASME B16.1, Class 125.
1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

E. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
   a. Available Manufacturers:
      1) Anvil
      2) Grinnell
      3) Shurjoint-Apollo
      4) Smith-Cooper
      5) Victaulic
   3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

2.05 STAINLESS-STEEL DRAINAGE PIPE AND FITTINGS
   a. Available Manufacturers:
      1) Josam
      2) Watts Industries
   B. Description: Comply with requirements of ASME A112.3.1, drainage pattern.
   C. Material: Type 304 or 316L stainless steel.
   D. Pipe Construction: Seamless.
   E. Joints: Single or double, socket and spigot ends.

2.06 DUCTILE-IRON PIPE AND FITTINGS
   A. Ductile-Iron, Mechanical-Joint Piping:
      1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot ends unless grooved or flanged ends are indicated.
      3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
   B. Ductile-Iron, Push-on-Joint Piping:
      1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot ends unless grooved or flanged ends are indicated.


C. Ductile-Iron, Grooved-Joint Piping: AWWA C151/A21.51, with round-cut-grooved ends according to AWWA C606.

D. Ductile-Iron, Grooved-End Pipe Appurtenances:
   a. Available Manufacturers:
      1) Anvil
      2) Shurjoint-Apollo
      3) Smith-Cooper
      4) Star Pipe Products
      5) Victaulic


3. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

2.07 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.

D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

E. Copper Pressure Fittings:
   2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
   1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.08 PVC PIPE AND FITTINGS (Below grade only)


B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

E. Solvent Cement: ASTM D 2564.

2.09 SPECIAL PIPE FITTINGS

A. Transition Couplings:
   1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   2. Unshielded, Nonpressure Transition Couplings:
      a. Available Manufacturers:
         1) Dallas Specialty
         2) Fernco
         3) Froet
         4) Mission Rubber Company
         5) Plastic Oddities
      c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
      d. End Connections: Same size as and compatible with pipes to be joined.
      e. Sleeve Materials:
         2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
         3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
   3. Shielded, Nonpressure Transition Couplings:
      a. Available Manufacturers:
         1) Cascade Waterworks
         2) Mission Rubber Company
      c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. End Connections: Same size as and compatible with pipes to be joined.

4. Pressure Transition Couplings:
   a. Available Manufacturers:
      1) Apollo Flow Controls
      2) Cascade Waterworks
      3) Dresser
      4) EBAA Iron
      5) Ford Meter Box
      6) Jay R Smith
      7) JCM Industries
      8) Romac Industries
      9) Viking Johnson
   c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
   d. Center-Sleeve Material: Manufacturer's standard.
   e. Gasket Material: Natural or synthetic rubber.
   f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. Dielectric Unions:
   a. Available Manufacturers:
      1) A.Y. McDonald
      2) Capitol Manufacturing
      3) Central Plastics Company
      4) Hart Industrial
      5) Jomar Valve
      6) Matco-Norca
      7) Watts Industries
      8) Zurn Industries
   b. Description:
      1) Standard: ASSE 1079.
      2) Pressure Rating: 125 psig minimum at 180 deg F.
      3) End Connections: Solder-joint copper alloy and threaded ferrous.

2. Dielectric Flanges:
   a. Available Manufacturers:
      1) Capitol Manufacturing
      2) Central Plastics Company
      3) Matco-Norca
      4) Watts Industries
      5) Zurn Industries
   b. Description:
      1) Standard: ASSE 1079.
      2) Factory-fabricated, bolted, companion-flange assembly.
      3) Pressure Rating: 125 psig minimum at 180 deg F.
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

3. Dielectric-Flange Insulating Kits:
   a. Available Manufacturers:
      1) Advance Products & Systems
      2) Calpico
      3) Central Plastics Company
      4) Pipeline Seal and Insulator
   b. Description:
      1) Nonconducting materials for field assembly of companion flanges.
      2) Pressure Rating: 150 psig.
      3) Gasket: Neoprene or phenolic.
      4) Bolt Sleeves: Phenolic or polyethylene.
      5) Washers: Phenolic with steel backing washers.

4. Dielectric Nipples:
   a. Available Manufacturers:
      1) Elster Perfection Corporation
      2) Grinnel
      3) Josam
      4) Matco-Norca
      5) Precision Plumbing Products
      6) Victaulic
   b. Description:
      1) Standard: IAPMO PS 66.
      2) Electroplated steel nipple.
      3) Pressure Rating: 300 psig at 225 deg F.
      4) End Connections: Male threaded or grooved.
      5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Refer to Division 312000 Section "Earth Moving" for excavating, trenching, and backfilling. Backfill soil shall be as per International Plumbing Code.

3.02 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil and waste piping: Note metallic piping only with the use of a return air plenum.
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
4. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.
5. Copper Type DWV tube, copper drainage fittings, and soldered joints.

C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
   4. Stainless-steel pipe and fittings gaskets, and gasketed joints.
   5. Copper Type DWV tube, copper drainage fittings, and soldered joints.
      a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.

D. Underground, soil, waste, and vent piping and smaller shall be any of the following:
   1. Service class, cast-iron soil piping; gaskets; and gasketed, calking materials; and calked joints.
   2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty or cast-iron hubless-piping couplings; and coupled joints.
   3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
   4. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

### 3.03 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified by civil engineer.

B. Basic piping installation requirements are specified in Division 220500 Section "Common Work Results for Plumbing."

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.

2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
   a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.

4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
   a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.
   1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
   2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
   3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
   1. Building Sanitary Waste: 1/4” per foot downward in direction of flow for piping NPS 2-1/2 and smaller; 1/8” per foot downward in direction of flow for piping NPS 3 and larger.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install steel piping according to applicable plumbing code.

O. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.

P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

Q. Install aboveground PVC piping according to ASTM D 2665.

R. Install underground PVC piping according to ASTM D 2321.

S. Plumbing Specialties:
   1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
      a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
      b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
   2. Install drains in sanitary waste gravity-flow piping.
      a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

U. Install sleeves for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing.

V. Install sleeve seals for piping penetrations of concrete walls and slabs.
   1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing.

W. Install escutcheons for piping penetrations of walls, ceilings, and floors.
   1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing.

3.04 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 220500 Section "Common Work Results for Plumbing."


D. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
   1. Cut threads full and clean using sharp dies.
   2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
      a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
      b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
      c. Do not use pipe sections that have cracked or open welds.

F. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

G. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

H. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
I. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

J. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.05 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in ODs.

B. Dielectric Fittings:
   1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.06 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 220529 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Install individual, straight, horizontal piping runs according to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 220529 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6: 60 inches with 3/4-inch rod.
F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 2-1/2: 11 feet with 1/2-inch rod.
   5. NPS 3: 12 feet with 1/2-inch rod.
   6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
   7. NPS 6: 12 feet with 3/4-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 2: 84 inches with 3/8-inch rod.
   2. NPS 3: 96 inches with 1/2-inch rod.
   3. NPS 4: 108 inches with 1/2-inch rod.
   4. NPS 6: 10 feet with 5/8-inch rod.

J. Install supports for vertical stainless-steel piping every 10 feet.

K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   3. NPS 2-1/2: 108 inches with 1/2-inch rod.
   4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
   5. NPS 6: 10 feet with 5/8-inch rod.

L. Install supports for vertical copper tubing every 10 feet.

M. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
C. Connect waste and vent piping to the following:
   1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
   5. Equipment: Connect waste piping as indicated.
      a. Provide shutoff valve if indicated and union for each connection.
      b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.08 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with
water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

E. Test sanitary drainage piping with smoke. Furnish instruments, equipment, and labor necessary to conduct tests.

F. Final Smoke Test:
   1. Produce smoke by smoke machine with pressure equivalent to 1 inch water column maintained for 15 minutes before inspection starts.
   2. Repair leaks.
   3. Repeat test until piping system holds smoke ten minutes without showing leaks.

3.09 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Repair damage to adjacent materials caused by waste and vent piping installation.

END OF SECTION 22 13 16
SECTION 22 1319 - SANITARY WASTE AND VENT SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.
   2. Roof flashing assemblies
   3. Floor drain

1.02 RELATED DOCUMENTS

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

1.03 RELATED SECTIONS

A. Section 220500 Common Work Results For Plumbing
B. Section 221316 Sanitary Waste and Vent Piping
C. Section 221413 Facility Storm Drainage Piping
D. Section 312000 Earth Moving.

1.04 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.
B. HDPE: High-density polyethylene plastic.
C. PE: Polyethylene plastic.
D. PP: Polypropylene plastic.
E. PVC: Polyvinyl chloride plastic.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating
   characteristics, and accessories.
B. Field quality control test reports.
1.06 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.


1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.01 CLEANOUTS

A. Cast-Iron Wall Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam
      b. Mifab
      c. Sioux Chief Manufacturing Company, Inc.
      d. Jay R. Smith
      e. Tyler Pipe
      f. Watts Industries
      g. Zurn Industries
   2. Standard: ASME A112.36.2M. Include wall access.
   3. Size: Same as connected drainage piping.
   4. Body: As required to match connected piping.
   5. Closure Plug:
a. Cast iron.
b. Countersunk head.
c. Drilled and threaded for cover attachment screw.
d. Size: Same as or not more than one size smaller than cleanout size.


B. Cast-Iron Exposed Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam
   b. Mifab
   c. Sioux Chief Manufacturing Company, Inc.
   d. Jay R. Smith
   e. Tyler Pipe
   f. Watts Industries
   g. Zurn Industries
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: As required to match connected piping.
5. Closure: Countersunk, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Yard Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam
   b. Mifab
   c. Sioux Chief Manufacturing Company, Inc.
   d. Jay R. Smith
   e. Tyler Pipe
   f. Watts Industries
   g. Zurn Industries
2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
7. Outlet Connection: Threaded.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Top Loading Classification: Medium Duty.
11. Size: Same as connected branch.

2.02 **ROOF FLASHING ASSEMBLIES:** See Architectural drawings and specifications.

2.03 **MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES**

A. **Sleeve Flashing Device:**
   1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

B. **Sleeve Flashing Device:**
   1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

C. **Stack Flashing Fittings:**
   1. Description: Counterflash-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
   2. Size: Same as connected stack vent or vent stack.

2.04 **FLOOR/SHOWER DRAINS**

A. **Cast-Iron or Stainless Steel Floor Drains/Sinks:**
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam
      b. Mifab
      c. Sioux Chief Manufacturing Company, Inc.
      d. Jay R. Smith
      e. Prier Products
      f. Wade
      g. Watts Industries
      h. Zurn Industries
      i. Schluter
   2. Standard: ASME A112.6.3.
   3. Features: See ‘General Plumbing Schedule’ for additional information.
PART 3 - EXECUTION

3.01 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 310200 "Earth Moving."

3.02 INSTALLATION

A. Refer to Division 220500 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
   1. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

D. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

G. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.04 IDENTIFICATION

A. Identification materials and installation are specified in Section 310200 "Earth Moving."
1. Use warning tapes or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.05 FLASHING INSTALLATION (Coordinate with Architectural drawings and specifications)

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft, 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3.07 PROTECTION

A. Protect cleanouts during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

C. Protect sanitary waste interceptors from damage during construction period.

D. Repair damage to adjacent materials caused by sanitary waste interceptor installation.

END OF SECTION 22 13 19
SECTION 22 14 13 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.01 SUMMARY
   A. This Section includes the following storm drainage piping inside the building:
      1. Pipe, tube, and fittings.
      2. Special pipe fittings.
      3. Encasement for underground metal piping.

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

1.03 RELATED SECTIONS
   A. Section 220500 Common Work Results For Plumbing.
   B. Section 221316 Sanitary Waste and Vent Specialties.
   C. Section 312000 Earth Moving.
   D. Section 334100 Storm Utility Drainage Piping.

1.04 DEFINITIONS
   A. PVC: Polyvinyl chloride plastic.

1.05 PERFORMANCE REQUIREMENTS
   A. Components and installation shall be capable of withstanding the following minimum working-
      pressure, unless otherwise indicated:
      1. Storm Drainage Piping: 10-foot head of water.

1.06 SUBMITTALS
   A. Product Data: For pipe, tube, fittings, and couplings.
   B. Shop Drawings:
1. Shop drawings and details of storm water drainage system. Detailing out of below ground roof drains to civil provided lines.

C. Field quality-control inspection and test reports.

1.07 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.


PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
   1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
   2. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.

2.04 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Available Manufacturers:
      b. Fernco, Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Co.
e. NDS, Inc.
f. Plastic Oddities, Inc.

2. Sleeve Materials:
   a. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   b. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Available Manufacturers:
      b. Mission Rubber Co.

PART 3 - EXECUTION

3.01 EXCAVATION
   A. Refer to Division 310200 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS
   A. Underground storm drainage piping shall be any of the following:
      1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
      2. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
      3. for joining dissimilar pipe materials with small difference in OD.

3.03 PIPING INSTALLATION
   A. Storm sewer and drainage piping outside the building are specified in Division 334100 Section "Storm Utility Drainage Piping."

   B. Basic piping installation requirements are specified in Division 220500 Section "Common Work Results for Plumbing."

   C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 221316 Section "Sanitary Waste and Vent Piping Specialties."
D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 220500 Section "Common Work Results for Plumbing."

E. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.

F. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Maintain swab in piping and pull past each joint as completed.

H. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
   1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

I. Install PVC storm drainage piping according to ASTM D 2665.

J. Install underground PVC storm drainage piping according to ASTM D 2321.

K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.04 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 220500 Section "Common Work Results Plumbing."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.05 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to storm drainage specialties.
3.06 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping with water and smoke. Furnish instruments, equipment, and labor necessary to conduct tests.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

E. Water Test:
   1. Apply water test to entire system or in sections.
   2. If entire system is tested, tightly plug openings in pipes except highest opening.
   3. Fill system with water to point of overflow.
   4. If system is tested in sections, tightly plug openings except highest opening of section under test.
   5. Fill section with water to 10 foot head of water.
   6. In testing successive sections, upper 10 feet of next preceding section shall be tested so that each joint of pipe in building except uppermost 10 feet of system has been subjected to test of 10 foot head of water.
   7. Keep water in system or in portion under test for one hour before inspection starts.
   8. System shall than be made tight at all joints.
   9. Repair leaks.
   10. Repeat test until system holds water for six hours without drop in water level.

F. Final Smoke Test:
   1. Produce smoke by smoke machine with pressure equivalent to 1 inch water column maintained for 15 minutes before inspection starts.
   2. Repair leaks.
   3. Repeat test until piping system holds smoke ten minutes without showing leaks.
3.07 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 14 13
SECTION 22 14 63 - FACILITY STORM-WATER RETENTION TANKS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Steel, nonpressure tanks.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including “Uniform General Conditions for State of Texas Construction Contracts Including Supplementary General Conditions for Projects Administered by the Texas Parks and Wildlife Department” apply to this Section.

1.03 RELATED SECTIONS

A. Section 220553 Identification For Plumbing Piping and Equipment.

1.04 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 storm-water retention tanks.

B. Shop Drawings:
   1. Include plans, elevations, sections, and details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Detail fabrication and assembly of storm-water retention tanks.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Performance: Facility storm-water retention tank, including structural reinforcement and foundation, shall be capable of withstanding the effects of dead and live gravity loads and winds of 100 mph.
B. Thermal Movements: Storm-water retention tank, including structural reinforcement and foundation, shall allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 STEEL, NONPRESSURE, STORM-WATER RETENTION TANKS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Corgal
   b. Adamson Global
   c. Highland Tank
   d. Reco
   e. Steel Tank and Fabricating
   f. John wood Co.

B. Description: Steel, vertical, nonpressure-rated tank with cylindrical sidewalls. See the remainder of part 2 for additional information.

C. Construction: Steel, constructed with welded joints.


A. Cover for Open Tank: Steel, with lining same as or similar to tank lining and with shape that encloses top of tank.

B. Specialties and Accessories: Include tappings in tank and the following: (additional refer to rainwater system details for additional information)

1. Free air vent with insect screen.
2. Roof panel with access hatch.
4. Roof ladder angles.
5. Anchor clips.
6. Preliner and main liner. Refer to manufacturer installation guidelines.

C. Vertical Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank before testing and labeling.
D. Exterior Coating: Galvanized.

1.02 STRUCTURAL MATERIALS

A. Water tanks shall be manufactured from high yield strength steel minimum of 57 ksi yield strength for wall panels. Wall sheets shall be continuous 2-2/3" depth x 1/2" pitch annularly corrugated galvanized steel, 20 gauge steel or heavier with minimum yield strengths of 57,000 psi. All zinc coating shall conform to G-115 (275 grams/square meter) specifications or higher. Bottom wall sheets have an inward return flange for additional bearing on foundation. Wall sheets shall have a coverage length of 9’ 4-1/2” (2,858 M) long, except for some 6’3” (1,905 MM) long sheets used adjacent to the access door. Holes in vertical seams shall be punched for single row or double row connections at 1-1/3” o.c (34 MM). Use of single row or double row of bolts at vertical seam is dependent upon diameter and depth of tank. Horizontal seams shall have a single lap connection with a maximum bolt spacing to be9-3/8” (238 MM). One-piece, 12 gauge (2.67 MM) or heavier galvanized steel die-formed or welded anchor clips shall be supplied for a minimum of one anchor clip per base wall panel. Anchor clips shall be bolted to the tank wall with four bolts to contact a concrete base. Water tank roofs shall have a 30° slope, and use single-stage self-supporting roof sheets. Roofs shall be designed for a 2 psf dead load, 20 psf live load, 20 psf snow load, and a peak equipment load rating of 2000 pounds (907 Kg). The tank shall be capable of being engineered for higher load ratings should the local conditions require it. Roof sheets shall have triangular sections of galvanized steel and a 90° formed drip edge at the eave. Roof panels shall be manufactured from G-115 galvanized steel conforming to ASTM A 446, Grade C, or greater. Roofs of tanks 9’ (2.74 M) diameter shall have 6 roof panels. Panels may have a non-ribbed, flat design type, with crimped edge designed to seal over wall sheets. Holes in the top ring wall sheets shall be factory punched for clip installation. Press-on bulb type neoprene eave seal and silicone caulking shall be used to seal between the top wall panel and the roof panel. Roof ladder cleats shall extend from eave to center cap. Ladder cleats shall consist of galvanized steel cold-formed angles of varying lengths bolted to top of one roof panel.

1.03 TANK ACCESS

A 22” round access hole with cover shall be at the top center of the roof access hole with hinged cover. For 9’ diameter tanks a round inspection hatch shall be located on the lower end of one roof sheet. A 20” X 40” bolted side access panel shall be located 22” above the floor on a side panel. The side access shall be bolted closed before final installation of the main liner.
1.04 TANK PENETRATIONS

Tank penetrations through the floor of the tank or the tank wall within the water storage level shall be completed utilizing modified schedule 80 PVC flange sets. Flanges shall be bolted together with stainless steel or brass hex head cap screws with bonded sealing washers at all liquid side holes. Liquid seam sealant may be used to ensure effective sealing. It is NOT acceptable to utilize flanges which use a single set of through-bolts which essentially “sandwich” the liner and flanges faces to the steel wall. This method may cause additional leak points and may compromise the structural integrity of the tank wall.

1.05 TANK FOUNDATION

The tank foundation shall be a concrete pad that will extend at least 9” outside of the tank wall in all directions. The foundation design and construction is not covered by this section of the specifications.

1.06 HARDWARE

All bolts and nuts shall be electro-galvanized with JS-1000 clear coat protective coating. Roof bolts shall have factory-installed steel-backed vinyl washers. Wall sheet bolts shall have slotted button heads for insertion from inside toward outside. All bolts shall be heat treated and meet SAE Grade 8.2 or stronger specifications.

1.07 FLEXIBLE MEMBRANE LINER

The flexible membrane liner shall have minimum a rated thickness of 24 mil (+/- 10%) and a minimum finished coated weight of 22.0 oz/yd2(+2/-1 oz/yd2). The liner shall be a PVC coated polyester fabric liner or polypropylene coated fabric reinforced liner. If the tank is intended for potable use, then the liner shall carry the NSF-61 certification. The liner shall be fabricated with a minimum of 1.5” factory welded seams and shall have a poly rope in the top hem for reinforcement. Metal or PVC grommets shall be evenly spaced along the top hem to facilitate the tank manufacturer method of liner hanging.

1.08 ANCHOR CLIPS

The anchor clips and anchor bolts shall conform to the structural design calculation package, if provided, and shall always meet site specific requirements to properly anchor the tank in accordance with seism is, wind load, and other environmental conditions. Anchor clips shall be placed no less than every 39” around the perimeter of the tank. Where seismic anchors are not required, the base anchor shall be a pre-formed anchor clip made of 12 GA. hot dipped galvanized steel which conforms to the tank wall corrugations. The anchor clip shall have a 1” hole in the base to accommodate the specified anchor bolt. The anchor clip shall be secured to the wall of the tank with no fewer than four 3/8” bolts. Where seismic anchors are not required, but wind loads or other environmental conditions exceed base tolerances, then a heavy duty anchor clip shall be used. The heavy duty anchor clip shall be made from 7 GA. hot dipped
galvanized steel. The anchor clip shall have a 1” hole in the base to accommodate the specified anchor bolt. The anchor clip shall be secured to the wall of the tank with no fewer than four 3/8” bolts. Where seismic anchor clips are required, an anchor “chair” shall be utilized with the anchor bolt extending through the base plate and through a 1” hole in the top plate of the chair. A minimum of 9 15/16” inches shall separate the two plates to allow for stretch of the anchor bolt during a seismic event. Additional spacing may be required for various duty of chairs. The anchor chair shall be secured to the wall of the tank with no fewer than six 3/8” bolts.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install storm-water retention tanks on concrete bases, level and plumb, firmly anchored. Arrange so devices needing servicing are accessible.

B. Anchor tank supports and tanks to substrate.

C. Install the following devices on tanks where indicated:
   1. Tank vents on nonpressure tanks.
   2. Connections to accessories.

D. After installing tanks with factory finish, inspect finishes and repair damages to finishes.

3.02 CONNECTIONS

A. Where installing piping adjacent to storm-water retention tanks, allow space for service and maintenance.

B. Connect water piping to water retention tanks with unions or flanges and with shutoff valves. Connect tank drains with shutoff valves and discharge to grade.
   1. Valves NPS 2 and Smaller: Gate valves complying with requirements in Division 22 Section “General Duty Valves For Plumbing Piping”.
   2. Valves NPS 2-1/2 and Larger: Gate valves complying with requirements in Division 22 Section “General Duty Valves For Plumbing Piping”.
   3. Drain Valves: NPS 3/4 Gate valves complying with requirements in Division 22 Section “General Duty Valves For Plumbing Piping”. Include outlet with, or nipple in outlet with, ASME B1.20.7, 3/4-11.5NH thread for garden-hose service, threaded cap, and chain.
   4. Water Piping Connections: Make connections to dissimilar metals with dielectric fittings. Dielectric fittings are specified in Section 221116 "Domestic Water Piping."

3.03 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
END OF SECTION 22 14 63
SECTION 22 33 00 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following electric water heaters:
   1. Light-commercial electric water heaters.
   2. Compression tanks.
   3. Water heater accessories.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including “Uniform General Conditions for State of Texas Construction Contracts Including Supplementary General Conditions for Projects Administered by the Texas Parks and Wildlife Department” apply to this Section.

1.03 RELATED SECTIONS

A. Section 220500 Common Work Results For Plumbing.
B. Section 221116 Domestic Water Piping.
C. Section 221119 Domestic Water Piping Specialties.

1.04 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
B. Shop Drawings: Diagram power, signal, and control wiring.
C. Product Certificates: For each type of commercial and instantaneous electric water heater, signed by product manufacturer.
D. Source quality-control test reports.
E. Field quality-control test reports.
F. Operation and Maintenance Data: For electric water heaters to include in emergency, operation, and maintenance manuals.
G. Warranty: Special warranty specified in this Section.
1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.06 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including storage tank and supports.
   b. Faulty operation of controls.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Owner Acceptance.
   a. Light-Commercial Electric Water Heaters:
      1) Storage Tank: Five years.
      2) Controls and Other Components: Five years.
   b. Compression Tanks: Five year(s).

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 LIGHT-COMMERCIAL ELECTRIC WATER HEATERS

A. Description: Comply with UL 174 for household, storage electric water heaters.

1. Available Manufacturers:
   c. Electric Heater Company (The); Hubbell Heaters Division.
   d. Heat Transfer Products, Inc.
   e. Lochinvar Corporation.
   h. Smith, A. O. Water Products Company.
   i. State Industries, Inc.

2. Storage-Tank Construction: Steel, vertical arrangement.
   b. Pressure Rating: 150 psig
   c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

3. Factory-Installed Storage-Tank Appurtenances:
   a. Anode Rod: Replaceable magnesium.
   b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
   c. Drain Valve: ASSE 1005.
   d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
   e. Jacket: Steel with enameled finish.
   f. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
   g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation, unless otherwise indicated.
   h. Temperature Control: Adjustable thermostat for each element.
   i. Safety Control: High-temperature-limit cutoff device or system.
   j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

4. Special Requirements: NSF 5 construction with legs for off-floor installation.


2.03 COMPRESSION TANKS

A. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

1. Available Manufacturers:
   a. AMTROL Inc.
2.04 WATER HEATER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working-pressure rating.

C. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.

D. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

E. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

F. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

2.05 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.
2.06 HOT WATER CIRCULATING PUMPS

A. Provide centrifugal type in-line circulating pumps with associated controls to circulate the hot water in domestic hot water systems where indicated on the Drawings.

B. Each pump shall be Inline Boosters with bronze impeller and bronze body, designed for installation in open systems.

C. Furnish an Allen Bradley Bulletin 600 manual starter with thermal overload protection for the control of each pump motor and aquastat with adjustable set point for thermostatic control of pump.

D. Furnish with each pump two ball type isolation valves, two unions, discharge check valve, thermometer, and aquastat. Provide gauge taps and cocks at inlet and outlet of each pump for testing.

E. Furnish each pump with an automatic timer switch capable of being set to turn off circulation pump. Provide fully automated seven-day programmable timer switch equal to Tork E100 Series, unless recirculating pumps are required to be controlled by the Building Management System.

F. Capacities of each pump shall be as scheduled on the Drawings.

G. Acceptable Manufacturers:
   1. Armstrong
   2. Grundfos
   3. Bell and Gossett
   4. TACO

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.
   1. Exception: Omit concrete bases for commercial water heaters if installation on bracket.
   2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.

F. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

G. Install pressure gage(s) on inlet and outlet of commercial electric water-heater piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

H. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

I. Fill water heaters with water.

J. Charge compression tanks with air.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
B. Perform the following field tests and inspections and prepare test reports:
1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safety. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

END OF SECTION 22 33 00
SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:
   1. Lavatory faucets.
   2. Sink faucets.
   3. Toilet seats.
   4. Protective Shielding Guards.
   5. Fixture supports.
   7. Flushometers.
   8. Lavatories.
  10. Service sinks.
  11. Shower Faucets
  12. Drinking Fountains

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including “Uniform General Conditions for State of Texas Construction Contracts Including Supplementary General Conditions for Projects Administered by the Texas Parks and Wildlife Department” apply to this Section.

1.03 RELATED SECTIONS

A. Section 220500 Common Work Results For Plumbing.

1.04 DEFINITIONS


B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.


1.05 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.


E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
1. Vitreous-China Fixtures: ASME A112.19.2M.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
3. Hose-Connection Vacuum Breakers: ASSE 1011.

I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
2. Brass and Copper Supplies: ASME A112.18.1.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
4. Floor Drains: ASME A112.6.3.
5. Grab Bars: ASTM F 446.
7. Off-Floor Fixture Supports: ASME A112.6.1M.

1.07 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures of unit shell.
   b. Faulty operation of controls, blowers, pumps, heaters, and timers.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period for Commercial Applications: One year from date of Substantial Completion.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
2. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
3. Flushometer Tank, Repair Kits: Equal to 5 percent of amount of each type installed, but no fewer than 2 of each type.
4. Water-Closet Tank, Repair Kits: Equal to 5 percent of amount of each type installed.
5. Toilet Seats: Equal to 5 percent of amount of each type installed.

PART 2 - PRODUCTS

2.01 LAVATORY FAUCETS

A. Lavatory Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. T & S Brass and Bronze Works, Inc.
   b. Chicago Faucets
   c. Sloan
   d. Delta
   e. Moen
2. Description: See plumbing schedule. Alternatives shall be approved by engineer, architect, and owner prior to purchase.

2.02 SINK FAUCETS

A. Sink Faucets:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. T & S Brass and Bronze Works, Inc.
   b. Delta
   c. Chicago Faucets
   d. Moen
2. Description: See plumbing schedule. Alternatives shall be approved by engineer, architect, and owner prior to purchase

2.03 TOILET SEATS

A. Toilet Seats:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. Toto
   b. Bemis Manufacturing Company.
   c. Church Seats.
2. Description: Toilet seat for water-closet-type fixture.
   a. Toto solid plastic, white, elongated, open front seat, less cover, combination check and self-sustaining hinges with stainless steel posts.

2.04 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Engineered Brass Co.
   b. Insul-Tech Products Co.; a Subsidiary of MVG Molded Products.
   c. McGuire Manufacturing Co., Inc.
   d. Plumberex Specialty Products Inc.
   e. TCI Products.
   f. TRUEBRO, Inc.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements. Provide for all ADA lavatories and sinks as required.
2.05  FIXTURE SUPPORTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Josam Company.
   3. Tyler Pipe; Wade Div.

C. Lavatory Supports:
   1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.

D. Sink Supports:
   1. Description: Type II, sink carrier with hanger plate, bearing studs, and tie rod for sink-type fixture. Include steel uprights with feet.

2.06  WATER CLOSETS

A. Water Closets:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
      a. Toto
      b. American Standard
      c. Sloan
   2. Description: See plumbing schedule.

2.07  FLUSHOMETERS

A. Flushometers,
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Sloan
      b. American Standard
      c. Or approved equal.
   2. Description: Flushometer for water-closet type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
      a. Internal Design: piston operation.
b. Style: Exposed.
c. Inlet Size: NPS 1.
d. Consumption: See schedule.

3. Warranty: 5-year manufacturer’s warranty.

2.08 LAVATORIES

A. Lavatories:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. Toto
   b. American Standard Companies, Inc.
   c. Sloan
   d. Kohler
2. Description: See plumbing schedule.
   a. Provide McGuire chrome riser supplies with loose key angle stops and chrome escutcheon plate with set screw.
   b. P-Trap: McGuire 1-1/4” x 1-1/2”, 17 gauge, chrome cast brass P-trap with cleanout plug and chrome escutcheon plate with set screw.
   c. Insulate exposed water supplies and drain piping with ADA approved insulation kit, equal to Truebro “Lav-Guard” Kit number 102 and 105.

2.09 COMMERCIAL SINKS

A. Two Compartment Sink
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. Advance Tabco.
   b. Elkay Manufacturing Co.
   c. Just Manufacturing Company.
2. Description: See plumbing schedule.
   a. Coordinate hole drilling closely with Architect.
   b. Provide Elkay model LK-35 stainless steel strainer with neoprene stopper for each drain.
   c. Provide McGuire 1-1/2” x 1-1/2”, 17 gauge, chrome cast brass P-trap with cleanout plug, and chrome escutcheon plate with set screw.
   d. Provide McGuire chrome riser supplies with wheel handle angle stops with chrome escutcheon plate with set screw.

2.010 SERVICE SINKS

A. Service Sinks: (Wall mounted mop sinks).
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Stern-Williams Co., Inc.
   c. Fiat
   d. American Standard

2. Description: Enameled, cast iron, trap standard mounted
   b. Type: Service sink with back.
   c. Back: Two faucet holes.
   e. Mounting: NPS 3 P-trap standard with grid strainer inlet, cleanout, and floor flange.
   f. Rim Guard: On front and sides.

3. Support: Type II sink carrier.
   a. Provide hose and hose bracket.
   b. Provide manufacture offered stainless steel wall guards.
   c. Provide with stainless steel mop hanger with (3) rubber spring loaded grips.

2.011 SHOWER FAUCETS

A. Shower Faucets:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Symmons Industries, Inc.
      b. Moen
      c. Leonard
      d. Powers
   2. Description: See plumbing schedule.
      a. Shower tiling shall be specified in other Division of Architectural specifications.
      b. Refer to drawings for drain specifications.
      c. All shower controls and heads shall be located per Architectural Drawings.

2.012 DRINKING FOUNTAINS

A. Water Coolers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elkay Manufacturing Co.
      b. Halsey Taylor.
      c. Haws Corporation.
2. Description: See plumbing schedule.
   a. Provide all stainless steel finish, unless designated otherwise by Architect.
   b. Provide with bottle filler per schedule.
   c. Furnish accessory apron when units are mounted on an exposed wall or necessary to provide the ADA mandatory underside clearance.
   d. Provide owner with 12 pack filter replacement.
   e. Provide McGuire chrome riser supply with wheel handle stop and chrome escutcheon plate with set screw.
   f. P-Trap: McGuire 1-1/4” x 1-1/2”, 17 gauge, chrome cast brass P-trap with cleanout plug and chrome escutcheon plate with set screw.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

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

3.02 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
   1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
   2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
   3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install counter-mounting fixtures in and attached to casework.

G. Install fixtures level and plumb according to roughing-in drawings.
H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
   1. Exception: Use ball valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

K. Install toilet seats on water closets.

L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

N. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

O. Install shower flow-control fittings with specified maximum flow rates in shower arms.

P. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

Q. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

R. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install on countertop at sink. Connect inlet hose to dishwasher and outlet hose to disposer.

S. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

T. Set shower receptors and service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
U. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.05 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.
3.06 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers’ recommended cleaning methods and materials. Do the following:
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 40 00
SECTION 22 42 70 – COMPOSTING TOILETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   B. General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY
   A. Section Includes:
      1. ADA Compliant Single Stall Composting Toilet Units
      2. ADA Compliant Two Stall Composting Toilet Units
   B. Related Requirements:
      1. Division 10 Section “Toilet Accessories”
      2. Division 22 Sections on Plumbing
      3. Division 26 Sections on Electrical
      4. Division 31 for Earth Work

1.03 ACTION SUBMITTALS
   A. Product Data Three (3) copies of manufacturer's specifications and descriptive literature.
      1. Include construction details, material descriptions, dimensions of individual components and profiles, and finish materials.
   B. Closeout Submittals:
      1. Operation and Maintenance Manuals.
      2. Maintenance schedule.

1.04 QUALITY ASSURANCE
   A. Erection shall be accomplished by a trained, competent erector having experience in delivery and installation of similar fabricated units.
   B. Install units in strict compliance with manufacturer's instructions and details.
   C. All bathroom fixtures and accessories shall comply with all ADA federal, state and local Handicapped code requirements.
   D. Inspection and Testing: In accordance with requirements of local jurisdiction, obtain required permits, inspections and tests.
   E. Prior to beginning work of this Section, attend a pre-installation meeting. Owner, Design Professional, and contractors with adjacent or related work shall attend.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Delivery
      1. Plan off-loading carefully. If a loading dock is available, a pallet jack can be used to slide the unit off the truck trailer. In situations where there is no dock, or the platform is significantly lower than the trailer bed, a forklift with extra-long tines, a backhoe, or some other lifting device will be needed to remove the unit from the trailer. Access to the
M54 in the trailer is only to its width, so forklift blades will have to be at least 5’ to reach the center of gravity. Several people should be present to assist in offloading.

B. Inspection:
   1. Typically, components are packed inside the composter for shipping. If the shipment is accepted, immediately cut the strapping, open the package, and remove the components packed inside. Identify the parts and check them against the Parts & Hardware list. Damage, shortages, and discrepancies must be reported to your local authorized representative or the manufacturer within 5 working days.
      a. Do not sign the shipping receipt until the carrier has noted the damage on the Bill of Lading.
      b. If major damage is observed DO NOT SIGN the shipping receipt. Refuse the shipment and immediately call manufacturer.

C. Storage:
   1. If the composter will not be installed immediately, secure all components in a safe location which is protected from the weather.

PART 2 - PRODUCTS

A. Pre-Engineered and Fabricated ADA-Compliant Bathroom Structure and Components

B. General: Composter base designed to be placed below grade and with handicapped accessible toilet stall building structure, without the need for a separate foundation or footings. The composter comprised of separate chambers for the composting of solid material and the storage of compost liquid. The compost system designed so that all maintenance access points are on top of the compost system.
   1. Certified by the National Sanitation Foundation under Standard 41

   1. Composter base manufactured of rotationally molded polyethylene and conforms to the following specifications:
      a. Composter Base: Length: 118” Width: 65” Base Height: 48”
      b. Building Size: Length: 93” Width: 72” Base Height: 112”
      c. Building Enclosure (Inside): Length: 82” Width: 60”
      d. Capacity for daily use at average temp. ≥ 65˚ F. 60 visits
      e. Annual use at average temp ≥ 65˚ F. 22,000 visits
      f. Constructed of high density linear polyethylene
         1) Density (ASTM 4883) 0.942 TG/CM3
         2) Tensile strength at yield (ASTM D638) 2700 PSI
         3) Dart Impact @ -40˚ C, 250 mils: 175 ft-lbs.
         4) Evnt. stress crack resistance (ASTM D1693) > 400 hrs.
      g. Solids storage capacity: 604 gallons
      h. Liquid storage capacity: 300 gallons

D. Basis of Design Two-Stall Units: Clivus Multrum Incorporated, M54W Trailhead “Ipswich”, comprised of two M54 compost tanks set side-by-side with two toilet stall structure above.
   1. The composter bases are manufactured of rotationally molded polyethylene and each conforms to the following specifications:
      a. Composter Base: Length: 118” Width: 130” Base Height: 48”
      b. Building Size: Length: 93” Width: 130” Base Height: 110”
      c. Building Enclosure (Inside): Length: 82” Width: 60” each stall
      d. Capacity for daily use at average temp. ≥ 65˚ F. 60 visits each stall
      e. Annual use at average temp ≥ 65˚ F. 22,000 visits each stall
f. Constructed of high density linear polyethylene
   1) Density (ASTM 4883) 0.942 TG/CM3
   2) Tensile strength at yield (ASTM D638) 2700 PSI
   3) Dart Impact @ -40˚ C, 250 mils: 175 ft-lbs.
   4) Evt. stress crack resistance (ASTM D1693) > 400 hrs.
g. Solids storage capacity: 604 gallons each stall.
h. Liquid storage capacity: 300 gallons each stall.

E. Walls and Roof:
   1. Expanded Polystyrene (EPS) panel core:
      a. Expanded Poly Styrene (EPS) core, 3-1/2” thickness, complies with Type 1
         requirements of ASTM C 578
   2. Exterior Wall Panel Facing:
      a. 7/16” OSB plywood
   3. Interior Wall Panel Facing:
      a. .060 smooth FRP
      b. Interior color: white
   4. Exterior Wall Surface:
      a. Prefinished fiber cement clapboard. Finish color as selected by Architect from
         Manufacturer’s full range of available colors.
   5. Roof Surface:
      a. Prefinished standing seam metal panels Finish color as selected by Architect from
         Manufacturer’s full range of available colors.

F. Floor Panel:
   1. Expanded Poly Styrene (EPS) panel core
      a. 5/16” Expanded polystyrene core with characteristics as above
   2. Top Face
      a. Top face is ½” plywood with .08” vulcanized rubber non-slip coating
   3. Bottom Face
      a. Bottom surface is ½” plywood with .060 embossed aluminum skin
   4. Maintenance Hatch
      a. Hatch construction same as floor but with aluminum diamond plate top surface for
         wear. Size: length 30”; width 67”

G. Doors:
   1. 25 gauge steel skin with foamed-in-place polyurethane core
   2. Factory primed, reference Division 09 “High Performance Coating” for final door finish.
   3. Heavy duty pneumatic door closer included

H. Door Knob Assembly
   1. Conforms to ANSI A156.2, Series 4000 Grade 1; UL listed
   2. Passage function is standard; lockable inside by push-button; not lockable from outside
   3. Lever handle is nickel plated; zinc alloy; latch and chassis are brass, corrosion-treated
      steel, or stainless steel
   4. Lever handle is approximately 4 3/4” long (from center line of chassis), conforms to
      California Administrative Code Title 19 and title 24, and to Illinois Accessibility
      Standard

I. Toilet
   1. Handicapped toilet; seat 18” above floor
   2. Toilet stool is constructed of impervious reinforced fiberglass with an industrial grade
      gel-coat
   3. Seat and lid are molded from ABS plastic
   4. Liner is rotationally molded from polypropylene
5. Connecting chute is 14” dia. and 10” high, polyethylene as above

J. Ventilation Tube:
   1. Length: 10’ Diameter: 4”
   2. Color: black
   3. Constructed from Schedule 40 ABS plastic

K. Fan
   1. 100 CFM
   2. Nominal voltage 12vDC
   3. Power input 17w
   4. Ball bearing motor
   5. Life expectancy at 40˚C 77,500 hrs.

L. Solar Components:
   1. Solar Panel:
      a. 12v output from semi crystalline solar cells laminated between sheets of ethylene vinyl acetate (EVA) and tempered glass with light blue Tedlar back sheet
      b. Superstrate is self-cleaning, highly transmissive impact resistant glass
      c. Extruded aluminum mounting frame with clear anodized finish
   2. Battery:
      a. Maintenance-free, valve regulated, sealed lead acid battery, designed for deep cycle photovoltaic applications
   3. Charger:
      a. Negative-ground switching shunt regulator housed in an anodized aluminum chassis and encapsulated in a hard epoxy resin
      b. 1 - 16 amp charging
      c. 100% solid state
      d. Blocking diode
      e. Charger mounted in a NEMA box

M. Grab Bars
   1. 1 1/4” stainless steel with white vinyl powder coat
   2. length: 42” each (2); 18” (1)
   3. ADA approved

N. Toilet Paper Dispenser:
   1. Made of stainless steel
   2. Two roll capacity
   3. Supplied with security lock

O. Accessories
   1. Nighttime light fixture in each stall

PART 3 - EXECUTION

3.01 SITEING AND PREPARATION

A. Compost tank can be placed on grade or buried to within 4 inches of the floor surface, see drawings for details. Contractor to verify site is well drained and not subject to flooding or a high-water table.

B. Verify drain-to-daylight be used to avoid flotation.

C. A sloping site is the easiest condition in which to create such a drain. Attempting to tie the composting unit to a concrete pad may result in distortion or tearing of the plastic tank.
D. When the unit is to be placed on grade, anchoring devices must be used to meet wind loading. Helical anchors are suitable for this purpose.

E. Berming up to within 4 inches of the floor surface or fencing around the compost tank may be done to improve appearance and reduce possible vandalism.

F. Positioning of the composter base must take into consideration ramping for wheelchair accessibility. The maximum depth of bury of the compost tank leaves the floor surface 4” above grade. Plan for grading up to the floor level at the front of the unit for ADA requirement. Any permanent ramp built up to the door must allow the maintenance hatch to remain operable. Any ramp should be sloped away from the front of the unit to avoid water intrusion.

G. Contractor to verify one face of unit roof will face south and be open to a 120º arc of sunlight to maximize collection for roof-mounted solar panels are used. This may mean trimming branches or trees to allow greater exposure. Pole-mounting of solar panels may be required to raise them above the tree canopy.

H. All handicapped bathroom fixtures and toilet accessories shall comply with all federal, state and local Handicapped code requirements and comply with TAS (Texas Accessibility Standards) mounting locations and heights.

3.02 INSTALLATION

A. Excavate Hole for Base: For the single-stall unit, dig a hole approximately 9-1/2' (W) x 12' (L) x 5' (D). For the double-stall unit, dig a hole approximately 15' (W) x 12' (L) x 5' (D). Level the hole and add about 80 cu. ft. of stone for the single stall unit; 160 cu. ft. of stone for the double stall unit. Level again.

B. Drain-to-daylight required to avoid upward pressure on the compost tank from ground water or run-off. This should be created now.

C. Place Composter Base Place with the Liquid End-Product Removal Port at the front on the leveled bottom of the hole. Check with the 4’ or 6’ level. Add or remove soil or stone until the Composter Base is level. Note: The top lip of the Composter Base should extend at least 2” above grade to avoid rainwater intrusion.

D. Place Anchors (for wind-loading only) Using two wire clips, attach a braided wire rope to each anchor plate. Use two more clips to attach the two free rope ends to the eye-bolts on the long side of the Base. Spread the plates out to the sides of the hole and fasten down using two stakes in each plate.

E. Backfill Around Base: Begin backfilling with remaining crushed stone and complete with soil. Compact the fill vertically rather than against the sides of the composter.

F. Install Vent System: Push the ABS fan assembly up through the vent hole in the floor and connect to the 4” coupling above. Do not glue! Turn the fan assembly so the fan faces to the right, parallel to the front of the building.

G. Add the entire three bales of planer shavings to the Compost Chamber (supplied with unit). Rake out the starter bed evenly.

H. Install toilet, toilet accessories and compost access lid per manufacturer’s instructions.

I. Provide licensed plumber or electrician be engaged, as required by local regulations, for final hook-ups. If

J. Electrical Components
   1. Install solar panels per manufacturer’s instructions and recommendations.
   2. Solar Power Wiring: The battery or batteries will sit on the shelf immediately behind the liquid removal port. The charge control box will sit on top of the battery. Leave at least 4
feet of wire from any device to the control box so that the box may be removed easily for repair or monitoring. Follow wiring instructions on the inside of the solar control box, using connectors provided.

3.03 CLEANING AND PROTECTION
   A. After completing installation, inspect and repair damaged finishes, verify functionality and adjust components.
   B. Clean units with manufacturers' recommended cleaning methods and materials.

3.04 DEMONSTRATION AND TRAINING
   A. Demonstrate each unit functionality and instruct Owner’s personnel in proper operating procedures and maintenance schedule.
   B. Provide owner complete set of any special tools required for maintenance and repairs.

END OF SECTION 22 42 70